SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER 1907.

GENERAL PHYSICS.

1606. *Tests of a Cast Steel Beam.* **J. V. McAdam.** (Eng. News, 58. pp. 118 and 119, Aug. 1, 1907.)—The deformation of the specimen, an unannealed cast steel bar, about 5 in. × 1 in. section, was observed as follows: One side of the bar was grooved by regularly spaced planing-machine cuts, both longitudinally and transversely. A record of the deformation at each stage in the loading was taken by laying a sheet of carbon paper and a sheet of plain paper on the side of the beam and passing a rubber roller over them. The measurements made from the diagrams are plotted; in no case does an observation err by more than $\frac{1}{100}$ in. from the mean curve. The elastic limit in tension occurred at 40,000 lbs. per sq. in. stress, and permanent set on unloading was observed at 47,000 lbs. per sq. in. Permanent set in compression occurred at about 50,000 lbs. per sq. in. The loading was carried to 100,000 lbs. per sq. in. without fracture. The effect of repeated unloading and reloading appeared to be merely to raise the elastic limit without weakening the metal seriously. The stresses were in all cases, however, calculated upon the ordinary theory for elastic strain. A tensile test of an annealed sample of the material (C, 0·24; Mn, 0·68; P, 0·028 per cent.) gave 15 per cent. elongation and 85,000 lbs. per sq. in. ultimate stress. F. R.

1607. *Tests of Cold-twisted Bars for Concrete Reinforcement.* **J. J. Shuman.** (Eng. News, 58. pp. 59–60, July 18, 1907. Eng. Record, 56. pp. 77–78; Discussion, p. 78, July 20, 1907. Paper read before the Amer. Soc. for Testing Materials, June 22, 1907.)—Gives results of tensile tests which show that the pitch of the twist in cold-twisted square bars should be from 8 to 10 times the side of the square for Bessemer steels of about 60,000 lbs. per sq. in. tensile strength, and from 5 to 7 times for basic open-hearth steels of similar grade. Under these conditions ultimate strength is increased 50 per cent. or more, and yield-point over 100 per cent. At least 5 per cent. elongation in 8 in. is to be expected. It is argued that these cold-finished rods are preferable to hot-twisted bars of higher carbon for reinforcement, chiefly on account of their high elastic limit. F. R.

1608. *Adhesion of Steel and Brass in Concrete.* **H. Bürchartz.** (Eng. Record, 56. p. 120, Aug. 8, 1907.)—The author gives the results of a number of tests in which a rod of steel or brass was drawn from a block of concrete in which it was embedded. The concrete was in many cases over 4 years old. The following are some averages :—

Concrete Mixture.	Rod.		Adhesion, lbs. per sq. in.	
	Material.	Diam., inches.	Smooth.	As rolled.
1:1:2	Steel	1	146	707
1:2:2		$\frac{7}{16}$	893	900
1:2:2		1	341	514
1:2:4		$\frac{7}{16}$	216	740
1:2:4		1	188	227
1:4:4		1	178	425
1:2:4	Brass	$\frac{7}{16}$	251	—
1:2:4		1	409	—

Generally greater adhesion is obtained with richer mixtures. When the embedded end of the rod was forked or hooked the loads required to extract it approached the breaking stress of the rod. F. R.

1609. *Thermal Conductivity of Concrete and Effect of Heat on Strength.* **I. H. Woolson.** (Eng. News, 58. pp. 166–168, Aug. 15, 1907. Paper read before the Amer. Soc. for Testing Materials, June 21, 1907.)—Further tests confirm the results previously reported [see Abstract No. 1662 (1906)]. The specimens were 1 : 2 : 4 in the case of trap and quartz gravel, and 1 : 2 : 5 for cinder. In the conductivity tests heat was applied to one end of the block for 2 hours only, 1,700° F. being reached in about 1 hour, and maintained. The cinder concrete conducted heat better than either the gravel or stone concrete, but the gravel concrete was badly disintegrated where severely heated. It is suggested in explanation that this is due to the high coefficient of expansion of quartz and the fact that it is different in the directions of the axes. Observations of temperature gradient along steel bars embedded in concrete, one end of the bar being heated in the furnace, showed it to be about the same as if the bar were simply in the air without any concrete surrounding it. Compression tests showed that all concretes are greatly deteriorated after heating to 1,000° F. F. R.

1610. *Cup-leather Friction in Hydraulic Presses.* **A. Martens.** (Zeitschr. Vereines Deutsch. Ing. 51. pp. 1184–1186, July 27, 1907.)—Tests on five presses show that the probable errors in working ranges lie well within ± 2·5 per cent. when the pressures are taken by gauge. Three of the machines were of 50 tons capacity of the Pohlmeyer type, the other two of the Martens type of 100 tons capacity. It is concluded that the accuracy is sufficient for all practical testing, to enable one to dispense with the lever weighing apparatus. F. R.

1611. *Rifled Projectiles in Air.* **A. Mallock.** (Roy. Soc., Proc. Ser. A. 79. pp. 536–549, Sept. 6, 1907.)—In a former paper it was shown that the distance which a pointed projectile (ogival-headed) would travel in air, when air resistance was the only force acting on it, could be very closely expressed by the formula $s = v't + (u_0/a)(1 - \epsilon^{-at})$ [see Abstract No. 1285 (1907)]. In the present paper the author examines the nature of the motion of such a projectile when gravity acts on it as well as air resistance. From a discussion of the motion of a gyrostat it is found that the complete effect of the air resistance on the shot is to produce, in addition to the general retardation of its velocity, two couples: one in the plane containing the axis of the projectile and the tangent to the trajectory, and one in the plane through the tangent at right angles to the first plane; also two forces, both normal to the direction of motion, parallel and perpendicular to the radius of curvature of the trajectory. If we take the algebraic sum of the horizontal and vertical components of the force at the centre of gravity of the projectile, the first produces drift, and the second acts to diminish the effective force of gravity. The reduction in the apparent force of gravity is very considerable and increases with the curvature of the trajectory, that is, as the velocity of the projectile diminishes. The relation between the lifting force and the apparent force of gravity (g') is given in the notes, and is also shown in a diagram. From the diagram it is clear that the value of g' is fairly well expressed by the equation $g' = g - (c/v_0)(v_0 - v)$. For the purpose of finding a general formula for ranges this is all we require, and subject to the condition that the angle of projection (α) is small enough for $\cos\alpha$ to be taken as unity, we can at once write:—

$$R = v't + (u_0/a)(1 - \epsilon^{-at}) \text{ ....(A)},$$

$$\alpha = [g - (c/u_0)(v_0 - v)]\left(\frac{C^2}{2R}\right) \text{ ....(B)},$$

where R is the range. In the actual construction of range tables it is often convenient to plot R and α in terms of t and then to take the simultaneous values, thus getting R in terms of α. There can be no doubt that these formulæ give the ranges with great accuracy when α is small, and even when α is as large as 10°, that is, when $\cos\alpha$ differs from unity by nearly 2 per cent., the agreement is still very close. The reason for this is that the difference between $\cos\alpha$ and unity, which should be taken into account in the range as given by equation (A) (in which the air is treated as being of constant density), is of the same sign and (with the larger guns) of nearly the same amount as the increase of range due to the diminished density of the air at the higher parts of the trajectory. A graphic method of finding the correction for variable atmospheric density is given in the notes. Tables are given of angles of elevation and ranges computed by equations (A) and (B) for a 12-in. gun, muzzle velocity 2,700 ft./sec., and also for a 6-in. gun, muzzle velocity 2,575 ft./sec., and it is shown that the results differ by only small amounts from those given in the most trustworthy of the ordinary range-tables.

A. W.

1612. *Aerodynamics.* **L. Orlando.** (Accad. Lincei, Atti, 16. pp. 939–948, June 16, 1907.)—The Military Engineering Brigade at Rome possesses a fan capable of providing an air current 80 cm. in sectional diam. and free from vortex motion. The author has used this apparatus to study a curious effect. A short stick of semicircular cross-section is mounted so as to turn about its own axis in a current of air proceeding at right angles to its length. If the stick is set spinning in either direction and the air current is turned on the velocity of rotation is considerably increased. Similar effects take place in the case of lunular and trapezoidal sections, less with rectangular sections and not at all with lenticular sections of the stick. The author attempts a qualitative explanation based upon the eddies produced by the rotation. E. E. F.

1613. *Measurement of Surface Tension.* **T. Renard** and **P. A. Guye.** (Journ. Chim. Physique, 5. pp. 81–112, 1907.)—Measurements of the rise due to capillary action were made *in vacuo* by Ramsay and Shield's method, and also in contact with air at atmospheric pressure. The difference between the calculated values of the molecular surface energy in the two cases does not exceed 0·5 per cent. The measurement without a vacuum is much simpler and hence is recommended. Values of the surface tension and molecular surface energy at various temperatures are given for a series of organic liquids. The method is inapplicable to readily oxidisable or to hygroscopic substances, and is limited to temperatures below the boiling-points of the liquids concerned. L. H. W.

1614. *Viscosity of Fluids.* **M. Brillouin.** (Comptes Rendus, 144. pp. 1151–1153, May 27, 1907.)—Two mechanisms contribute to the transportation of a given property from one part of a fluid to another. One of these is the transport of the molecules themselves, as chiefly happens in gases, and the other is the communication of the property from one molecule to another by shock. In gases, the latter mode is almost negligible. The author tentatively puts forward the following formula for the viscosity of fluids :—

$$\text{(I)} \qquad \eta = \tfrac{1}{3}\rho\Omega\left(\alpha(\lambda + 2\text{R}) + \beta\frac{2\text{R}^2}{\lambda}\right)$$

with—

$$\text{(II)} \qquad \lambda = \frac{\Lambda}{\rho}\,\frac{\text{T}}{\text{T}+\text{C}} \quad \text{(low densities)}$$

and—

$$\text{(III)} \qquad \lambda = 1{\cdot}19 \times 10^{-8}\text{M}^{\frac{1}{3}}\rho^{-\frac{1}{3}} - 2\text{R} \quad \text{(high densities)}$$

where ρ is the density of the fluid ; M the molecular mass ; 2R the diam. of a molecule ; λ the mean free path ; Ω the speed of molecular agitation, connected with the absolute temperature T by the formula $\Omega = 15{,}800\ \text{T}^{\frac{1}{2}}\ \text{M}^{-\frac{1}{2}}$ c.g.s., as in gases; A and C the two constants of Sutherland's rule ; α and β two universal constants differing little from unity. The author controls this formula by means of Holman's work on CO_2, and finds that the diffusion by shock is considerably less than that by transport, but still comparable with it. E. E. F.

1615. *Earthquake Zones in Central Japan and in the Shinano-gawa Valley.* **F. Omori.** (Physico-Mathematical Soc., Tokyo, Proc. 4. 6. pp. 126–131, July, 1907.)—The four principal islands of Japan are grouped in a curve slightly of **S** shape, and the point of inflection is in the main island at a spot where the land is narrowed in by two bays on the opposite coasts—the bays of Tsuruga and Ise—and further by the lake of Biwa, situated between these bays. Lake Biwa is approximately a right-angled triangle, the two longer sides facing the bays, and situated in a depression zone. Lines parallel to the three sides mark the three chief earthquake zones of Central Japan, as the author shows by reference to the five most destructive historical earthquakes since 1596, and to other earthquakes. In the Shinano-gawa Valley five great earthquakes have occurred in the period 1886–1899. The centres of these earthquakes were in a fairly straight line running north to south, and the historical sequence is 2, 1, 4, 3, 5; after 2, 1, 3 had occurred, shocks at 4 and 5 were to be expected, the author points out. All the five earthquakes happened in July, the first two nearly on the same day, the first on July 23, the second on July 22. H. B.

1616. *Sun's Motion Relative to the Æther.* **C. V. Burton.** (Nature, 76. p. 349, Aug. 8, 1907.)—The author states that, so far as is known, it has not been pointed out that the velocity of light as deduced from the observed times of occultation of Jupiter's satellites is affected to the first order by the motion of Jupiter and the earth with respect to the æther. Taking the times best suited to such observations, when the distance between the two planets is very nearly a maximum or a minimum, there will be no appreciable relative velocity in the line of centres and to a first approximation, the velocity with which light from Jupiter approaches us is then made up of the true propagation velocity increased by the common velocity component of the two planets in the direction earth to Jupiter. In order to determine the sun's motion with respect to the æther, the values for the apparent velocity of light deducible from the observed times of occultation might be analysed, so as to discover any systematic differences depending on the direction of the line of centres. Only very small corrections would be needed on account of the motion of the planets relatively to the sun. The probable absolute error in the finally deduced velocity of the sun (relatively to the æther) would be of the same order as that affecting the finally deduced velocity of light. The quantity to be determined might perhaps be swamped by the errors of observation, but even so a superior limit could be assigned to the sun's velocity through the æther. Two of the three rectangular components of that velocity being measured in the plane of the ecliptic, the determination of the third component would unfortunately be badly conditioned. C. P. B.

1617. *Total Eclipse of the Sun of August* 30, 1905, *observed at Cistierna, Spain.* **A. Lebeuf** and **P. Chofardet.** (Comptes Rendus, 145. pp. 410–412, Aug. 19, 1907.)—The authors participated in an expedition sent by the Bureau des Longitudes. Owing to bad weather it was impossible to observe totality, but 1st and 4th contacts were observed through cloud, and measures were made of the common chord. The eclipse wind, N.W., was noticed forty minutes before totality. The barometric variation was nearly insensible, that of the thermometer about 3·4° C. The detailed account of the results will be given in the report to the Bureau des Longitudes. A. E.

1618. *Observations of Mars.* **R. Jarry-Desloges.** (Soc. Astronomique de France, Bull. p. 370, Aug., 1907. Abstract in Nature, 76. p. 451, Aug. 29, 1907.)—Observations made during July, 1907, at a temporary observatory on the summit of the Revard, at an altitude of 1,550 m. The doubling of the Solis Lacus is confirmed, and special mention made of the cloudy appearance of the Martian landscape in the northern hemisphere as compared with the clearly cut features of the southern hemisphere. The canal Ganges was seen very broad, and appeared double. On July 19 the region north of Lacus Niliacus was clear, but twenty hours later, on July 20, white spots were visible, suggesting the disappearance of clouds. C. P. B.

1619. *Mars in* 1907. *Observations at the Lowell Observatory.* **P. Lowell.** (Nature, 76. p. 446, Aug. 29, 1907.)—The results exceed expectation, in view of the unfavourable southern declination of the planet. Work was begun in March, 3½ months before opposition, so that the polar caps could be observed at the interesting phase when the southern one had its maximum, the northern its minimum, extent. In one respect the occasion was exceptionally propitious, for the planet was "upon an even keel" as regards the earth, the equator lying nearly in the plane of sight. The southern cap at first stretched across 95° of latitude, the northern only over 8°. Subsequent observations bore out the testimony of the two previous oppositions as to the curious manner in which the northern cap is formed [see Lowell Observatory Bulletin 30]. In addition to noting changes in both polar caps, the observers watched the development of the canal system in the antarctic and south temperate zones. After the melting of the south polar cap had got well under way, canals began to make their appearance about it, running thence down the disc. These canals left the cap at its edge and joined the rest of the system in lower latitudes. In connection with these polar phenomena, the light region, Thaumasia, lying around the Solis Lacus, first showed symptoms of awaking activity. The Solis Lacus appeared composed of two portions, a large oval patch on the east and a smaller round one on the west. Of the canals joining it to the dark areas, those on the south were now darker and more pronounced than those running north. Meanwhile the equatorial canals were steadily fading out. The process of evolution was similar to that observed during the northern presentation in 1903. Photographs show more detail than at the last opposition owing to the increased size of the disc. Fifty-six canals have been counted on various plates, the twin Gihon has been photographed double, and such delicate markings as Fons Juventæ and the little canals leading to it appear unmistakably in the prints. Such larger matters as the dwindling of the southern snow-cap show well, and it seems as though the scheme of settling points of Martian topography by measures of photographs was in process of realisation. The paper is illustrated by three reproductions of photographs of the disc, with Solis Lacus near the central meridian. Some 8 canals radiating from Solis Lacus, together with a few others in its near neighbourhood, are shown sharply and distinctly; two or three long, faint ill-defined bands can also be traced crossing the body of the planet further north. A. E.

1620. *Quickly-changing Variable Star.* **N. Ichinohe.** (Astronom. Nachr., No. 4194. p. 293, Aug. 2, 1907. Nature, 76. p. 389, Aug. 15, 1907.)—The variable star 37, 1906, Draconis, is found to have a period of 10h. 37m. 35s. The light increases from minimum (11·6 mag.) to maximum (10·9 mag.) in about 3 hours, decreases to minimum in about 5 hours, and remains at minimum for the remainder of the period. C. P. B.

1621. *Comet* 1907*d.* **E. Esclangon.** (Comptes Rendus, 145. pp. 409–410, Aug. 19, 1907. Extract.)—The comet was observed on Aug. 1 and 4, with the large equatorial of Bordeaux Observatory. On Aug. 1 it was easily seen with the naked eye. In the telescope the nucleus was very bright, and appeared like a star of magnitude 5½, surrounded by a nearly circular nebulosity. Though the comet was low on the horizon, the nucleus showed no scintillation. From this the author deduces that it possessed a sensible diameter. The apparent diam. was 8″, which would correspond to an actual breadth about 18 times the diam. of the earth. The head of the comet consisted of a dense nebulosity about 5′ in diam. surrounding the nucleus. It was not symmetrically disposed. On the side opposite the tail it showed a fan-like radiation in the form of a series of aigrettes. The tail, which was long but comparatively faint, branched into seven, the outer members being much shorter than the middle ones. Position observations of the comet are given for July 31 and Aug. 3. A. E.

REFERENCES.

1622. *New Apparatus for Polishing Metal Sections.* **K. W. Zimmerschied.** (Amer. Chem. Soc., Journ. 29. pp. 855–858, June, 1907.) F. R.

1623. *Cross-strain in Swiftly-rotating Discs.* **A. Stodola.** (Zeitschr. Vereines Deutsch. Ing. 51. pp. 1269–1274, Aug. 10, 1907.)—A description of researches in connection with turbine wheels and a mathematical discussion of theory based on the theory of elasticity. A. W.

1624. *Problem in Elasticity.* **R. Girtler.** (Phys. Zeitschr. 8. pp. 507–509, Aug. 1, 1907.)—Solves the following problem: Let two isotropic bodies of different elastic constants be in actual contact over a given surface and be acted upon by no volume forces except their weights. It is required to determine the surface forces for a maximum and for a minimum value of the dilatation. E. H. B.

1625. *Gravitational Force in Gases and Liquids.* **V. Crémieu.** (Soc. Franç. Phys., Bull. 1. pp. 33–47, 1907. Journ. de Physique, 6. pp. 284–298, April, 1907.)—A continuation of a previous research [see Abstract No. 274 (1906)], the experimental method being modified in several respects. It is concluded that in a very convergent gravitational field a body immersed in a liquid appears to be acted on by something more than the difference between the hydrostatic upthrust and the Newtonian attraction. G. E. A.

1626. *Rays and Wave Surfaces in Isotropic Media.* **A. Garbasso.** (Accad. Lincei, Atti, 16. pp. 41–45, July 7, 1907.)—The problem of determining the form of light rays and wave surfaces in any medium in which the refractive index is a known function of coordinates is dealt with. S. G. S.

1627. *Propagation of Long Earthquake Waves.* **E. Rosenthal.** (Phys. Zeitschr. 8. pp. 510–512, Aug. 1, 1907.)—A mathematical discussion of the propagation from an interior point source, of long earthquake waves. E. H. B.

1628. *Normal Rotation of Planetary Satellites.* II. **S. T. Preston.** (Phil. Mag. 14. pp. 265–272, Aug., 1907.)—A short discussion as to whether the rotation of planetary satellites should be direct or retrograde. [See also Abstract No. 217 (1907).] C. P. B.

LIGHT.

1629. *Glass Transparent to Ultra-violet.* **C. Fritsch.** (Phys. Zeitschr. 8. pp. 518–519, Aug. 1, 1907.)—A preliminary communication, containing the recipe for making a durable glass which is transparent to ultra-violet as far as the Al line 1852 Å.U. Six gm. of commercial $CaFl_2$ are mixed with 14 gm. of B_2O_3, both in powdered form, and melted in a platinum crucible on a gas furnace. The resulting fluid can be poured out on an unheated sheet of platinum, too rapid cooling being avoided. With the quantities named, thick pieces, without a single scratch, were frequently obtained about the size of a large half-crown. G. E. A.

1630. *New Method of Direct Measurement of Double Refraction in Strained Glass.* **L. N. G. Filon.** (Roy. Soc., Proc. Ser. A. 79. pp. 440–442, Aug. 2, 1907.)—Let a horizontal beam of parallel homogeneous light fall normally upon the face of a rectangular glass slab, and let the slab be under flexure in a vertical plane perpendicular to the direction of the incident light. Let $C_1 =$ stress-optical coefficient for the ray polarised in the plane of the cross-section and for light of the given wave-length. Then if $M =$ bending moment, $I =$ moment of inertia of the cross-section about the neutral axis, $\tau =$ thickness of slab, the retardation of a ray passing through at a distance y from the neutral axis is $(C_1 M\tau/I)y$. Thus the points at which the disturbance is in the same phase, instead of lying upon a line XY perpendicular to the neutral axis, lie upon a line inclined to XY at an angle $\theta_1 = C_1 M\tau/I$. Such a slab under flexure will therefore deflect the wave-front like a prism, and will do the same, only to a different extent, to the wave polarised in the perpendicular direction. If such a beam is analysed by means of a grating, the spectrum lines all appear doubled, the two components being oppositely polarised. If ϕ be the angle of incidence on the grating, ψ the angle of diffraction of the wave of length λ, then $\sin\phi - \sin\psi = n\lambda$, n being the number of lines per unit breadth of the grating. Whence $d\psi/d\phi = \cos\phi/\cos\psi$. Therefore the shifts of the spectrum line corresponding to wave-length λ due to the effect of strain on the two oppositely polarised rays are $\theta_1\cos\phi/\cos\psi$, $\theta_2\cos\phi/\cos\psi$. By measuring these shifts, θ_1, θ_2 and therefore C_1, C_2 can be found. Hence the *absolute* changes in the two indices of refraction can be calculated, and this not only for one kind of light, but for as many kinds at once as there are lines visible in the spectrum under observation. Actual experiment with a borosilicate glass, the total thickness traversed being 6 cm. and the difference of relative retardation per cm. height about 10 wave-lengths for sodium light, showed the doubling most clearly. J. J. S.

1631. *Speed of Invisible Rays of Spectrum.* **P. R. Heyl.** (Frank. Inst., Journ. 164. pp. 81–112, Aug., 1907.)—This memoir was submitted for the Boyden Premium, which was offered in 1859 to "any resident of North America who shall determine by experiment whether all rays of light, and other physical rays, are or are not transmitted with the same velocity." It was accepted by the judges as a valid solution of the problem for the ultra-violet rays, but part of the premium fund was retained for any one who might solve the problem in regard to the infra-red rays.

The principle of the experiment is as follows. Let there be a source of white light at a great distance from the observer, and suppose this source to suffer a periodic variation in intensity. Let the light which reaches the observer be dispersed into a spectrum by a prism or a grating. If all the different components of the white light travel at the same speed, every part of the spectrum will have its maximum or minimum of intensity at the same moment; but if the speed is a function of the wave-length this will not be the case. The only source of light at a practicable distance for such an experiment is a star. We have in the star Algol (β Persei) an almost ideal source of light for such an experiment. Ordinarily of the second magnitude, once in about three days (2d. 20h. 48·9m.), as is well known, it suffers a rapid diminution in brightness and an equally rapid recovery, occupying some seven hours in all, and involving a change in brightness of over one magnitude. This periodic darkening is ascribed to the star's revolution round a dark companion. The great distance of Algol, about 30 light-years, enables the observer to make a very delicate comparison of the speeds of light of different wave-lengths, for a difference of speeds of one part in a million would make the minimum impressed upon the faster waves reach us 16 min. before the other. The experiments were carried out by exposing a suitable photographic plate to the spectrum of the star, and a number of successive and equally timed exposures were made on the one plate, extending over a period of four or five hours, and so arranged that the instant of visual minimum, as given by the ephemeris, should be midway in the central exposure of the series. If, when the plate was developed, every portion of the spectrum exhibited its minimum of intensity on the same photographic image, the speed is the same for all wave-lengths. The effect produced by a difference of speed of travel would be to cause the minima of intensity for different regions of the spectrum to appear on different images. The region of the spectrum dealt with lies between 468 $\mu\mu$ in the blue and 300 $\mu\mu$ in the ultra-violet. The speed of the rays within this range was determined to be constant to one part in a quarter of a million. E. H. B.

1632. *Dynamical Theory of Gratings.* **Rayleigh.** (Roy. Soc., Proc. Ser. A. 79. pp. 399–416, Aug. 2, 1907.)—In the usual theory of gratings, upon the lines laid down by Fresnel, the various parts of the primary wave-front after undergoing influences, whether affecting the phase or the amplitude, are conceived to pursue their course as if they still formed the fronts of waves of large area. This supposition, justifiable as an approximation when the grating interval is large, tends to fail altogether when the interval is reduced so as to be comparable with the wave-length. A simple example will best explain the nature of the failure. Consider a grating of perfectly reflecting material, whose alternate parts are flat and parallel and equally wide, but so disposed as to form a groove of depth equal to a quarter wave-length, and upon this let light be incident perpendicularly. Upon Fresnel's principles the central regularly-reflected image must vanish, being constituted by the combination of equal and opposite vibrations. If the grating interval be large enough, this conclusion is approximately correct, and could be verified by experiment. But now suppose that the grating interval is reduced until it is less than the wave-length of the light. The conclusion is now entirely wide of the mark. Under the circumstances supposed there are no lateral spectra, and the *whole* of the incident energy is necessarily thrown into the regular reflection, which is accordingly total instead of evanescent. A closer consideration shows that the recesses in this case act as resonators in a manner not covered by Fresnel's investigations, and illustrates the need of a theory more strictly dynamical.

The present investigation, of which the interest is mainly optical, may be regarded as an extension of that given in the author's "Theory of Sound (1896, §272*a*), where plane waves were supposed to be incident perpendicularly upon a regularly corrugated surface, whose form was limited by a certain condition of symmetry. Moreover, attention was there principally fixed upon the case where the wave-length of the corrugations was long in comparison with that of the waves themselves, so that in the optical application there would be a large number of spectra. These restrictions are here dispensed with. On the other hand, it is now supposed that the *depth* of the corrugations is small in comparison with the length of the waves. Solutions are then obtained for the two principal cases corresponding respectively to the electric vector *parallel to* and *perpendicular to* the lines of the grating. In the second case, though not in the first, the intensity of a spectrum may become infinite through the evanescence of certain terms, which occurs when the spectrum is just disappearing from the field of view. Some experiments by Fraunhofer and some by Wood are also discussed in the light of the present theory. E. H. B.

1633. *The Magnetic Rotation of Sodium Vapour at the D Lines.* **R. W. Wood.** (Phil. Mag. 14. pp. 145–152, July, 1907.)—This paper contains measurements of the magnetic rotation carried to much greater accuracy than in the previous paper [Abstract No. 2177 (1905)]. The difficulty of keeping the rotations constant was overcome by the use of an electric heater placed round the tube containing the sodium vapour. Photographic records were obtained, and curves are given of the results from these and from visual measurements. The author confirms the agreement between his results and those required by Drude's formula developed on the hypothesis of the Hall-effect. This agreement, however, only holds good for the region outside the D lines. It is probable that the rotatory power between these lines is not symmetrical with respect to the lines, and if this is so the same should be true for the dispersion; and the author proposes to determine the latter with greater accuracy than has been done before. E. C. C. B.

1634. *Origin of Spectral Series.* **W. Ritz.** (Comptes Rendus, 145. pp. 178–180, July 16, 1907.)—In a previous communication [Abstract No. 823 (1907)] the author endeavoured to form a system emitting the whole of the hydrogen vibrations, starting from the hypothesis of an electron P under the sole action of a magnetic field H. The frequency ν of the resulting circular vibration is equal to the product of H by a universal factor K. Conserving the same hypothesis, a simpler result, and one more in harmony with received ideas, may be obtained by attributing this field H to a straight magnet having the point P in its prolongation. Let r_1 and r_2 be the distances of the magnet poles from P, and $\pm\mu$ their magnetic charges. Then $\nu = K\mu(1/r_1^2 - 1/r_2^2)$, $(r_1 < r_2)$. This formula becomes identical with Balmer's, $\nu = N(1/2^2 - 1/m^2)$ $(m = 3, 4, 5 \ldots)$, if the bar magnet be supposed composed of $m - 2$ equal magnets, of length a, placed end to end, the distance of P from the first magnet being $2a$. (To a distance a of P corresponds a series in the extreme ultra-violet; to $3a$, $4a \ldots$ infra-red lines). Then $r_1 = 2a$, $r_2 = ma$, $N = K\mu/a^2$. In the various molecules of a mass of glowing hydrogen all the modifications corresponding to 1, 2, 3 . . . magnets should be found, the number corresponding to n being less frequent the greater is n. The author justifies this conception by considering the hydrogen atom as very complex, and noting that every body of revolution rotating round its axis may, by a suitable distribution of its electric charge, become equivalent to a linear magnet. By supposing the first magnet to be unequal to the others, and of length $a/2$, we get Pickering's formula for the hydrogen rays in ζ Puppis. Rydberg's general formula $\nu = \mathrm{A} - \mathrm{N}/(m + \beta)^2$ may be obtained by giving independent values both to the length of the first magnet and to r_1. By making the lengths of the remaining magnets also differ from a, but approximate to a as m increases, the formula—

$$\nu = \mathrm{A} - \frac{\mathrm{N}}{[m + \beta + c(\mathrm{A} - \nu)]^2}, \quad (m = 1, 2, 3 \ . \ . \ .)$$

can be derived, which the author has elsewhere [Abstract No. 2596 (1904] shown to represent the spectral series with great accuracy. Again, by keeping the length and position of the other magnets invariable, while changing the length of the first, a new series of lines is obtained with wave-lengths having a constant difference from those of the preceding series. This is a generally observed phenomenon in linear spectra. If, on the other hand, we keep the position of the first pole, and therefore the quantity r, unchanged, and vary the length of the first magnet, we get a series of double lines converging to the same limit. This case is realised in the principal series, and the satellites of the secondary series. Lines, generally infra-red, corresponding to $m = 0$, or to negative values of ν, will not be observed—a conclusion which has been verified for the first case by observations of He, Cd, Zn, &c. A. E.

1635. *Ultra-violet Emission of Carbon in Certain Flames.* **A. Amerio.** (Accad. Sci: Torino, Atti, 42. 10. pp. 371–374, 1906–1907.)—The flames of illuminating gas and of acetylene have an appreciable emission in the ultra-violet portion of the spectrum which, with acetylene, reaches beyond $\mu = 0{\cdot}31$. In all cases the more highly refracted part of the spectrum exhibits well-marked maxima resembling very narrow bands, which are clearer if the flame is surrounded by a silver tube, although the remainder of the emission spectrum does not differ appreciably from that given by a free flame. The emission of carbon in these two flames may be divided into two parts corresponding with the two states through which it passes after liberation from the hydrocarbons. The first of these, due exclusively to carbon existing in the interior of the flame, is a continuous temperature spectrum. The second, which is due possibly to the carbon in the act of burning in the mantle of the flame, or to the products of its combustion, is a band spectrum, and its relatively high intensity may depend either on the high temperature of the mantle of the flame or on the chemical excitation of the reaction. [Compare Abstract No. 276 (1907).] T. H. P.

1636. *Band Spectra of Copper Halogen Salts.* **R. Derichsweiler.** (Zeitschr. Wiss. Phot. 4. pp. 401–417, 1907. Chem. Zentralblatt, 1. p. 618, 1907. Abstract.)—The spectra were photographed, using a small concave grating of 1 m. curvature ; the range was from the yellow to the ultra-violet. The salts were mixed with the corresponding ammonium salts in order to reduce the quantity of bromide or iodide dissociated, a coal-gas oxygen flame being used. It was found that the law "that the squares of the molecular

weights of nearly allied compounds vary inversely as the cubes of the frequency-differences," holds in the case of those bands of the spectra of the compounds which correspond with one another when arranged in series.
L. H. W.

1637. *Fluted Spectrum of Titanium Oxide.* **A. Fowler.** (Roy. Soc., Proc. Ser. A. 79. pp. 509–518, Sept. 6, 1907.)—It has been shown in a previous paper [Abstract No. 1604 (1904)] that most of the dark flutings which are characteristic of the spectra of Antarian or third-type stars correspond with flutings which appear in spectra obtained from oxide and chloride of titanium, but it was then uncertain whether the flutings originated in the vapour of the oxide or in that of the metal itself. The present paper gives evidence for the conclusion that the flutings in question are produced by a compound of titanium with oxygen. Numerous experiments have been undertaken, the most decisive being those with $TiCl_4$, a heavy volatile liquid, the vapour of which rapidly combines with oxygen on exposure to moist air, forming dense fumes of titanium oxychloride. It was definitely found that the spectrum of the pure chloride was free from the Antarian series of flutings. Detailed wave-lengths are given, with a discussion of the coincidences in stellar spectra, and an excellent plate of the spectrum from λ4600 to λ7200 accompanies the paper.
C. P. B.

1638. *Variation of Absorption Bands of a Crystal in a Magnetic Field.* **W. M. Page.** (Cambridge Phil. Soc., Trans. 20. No. 13. pp. 291–322, Aug. 15, 1907.)—In March and April, 1906, J. Becquerel gave an account of observations on the effect of a magnetic field on the absorption bands of xenotime, a uniaxal substance giving sharp bands. Two regions, one in the green and one in the red, were observed, and it was found that a diffusion and doubling of the bands occurred, analogous to the Zeeman-effect for metallic vapours. [See Abstracts Nos. 886, 1056 (1906).] The present investigation discusses the subject analytically, and leads to the following conclusions: (1) If the electron is easily displaced from its equilibrium position a large separation of the components of the doublet will result from the action of a magnetic field. (2) If the friction is small, the bands will be very dark and narrow, while if the friction is large the bands will be wide, and not very intense, *i.e.*, they will shade off very gradually from the point of maximum intensity. Thus, if the friction is large the band has much the same intensity throughout a large portion of its breadth, and so, when the crystal is acted on by a magnetic field, the components of the resulting doublet will run into one another, and the separation will not be observed. The band, however, on the whole, will increase in breadth. This explains how, in some cases, the bands are observed merely to broaden, without being doubled. (3) The fact that some of the bands observed broaden for some directions of the vibrations and separate for others is held to indicate that the friction is different in different directions. (4) The vibrations are preferably ascribed to *negative* electrons in *all* cases, it being held that in the neighbourhood of the systems which give "inverse" displacements the magnetic field changes sign, *i.e.*, that these inverse effects are diamagnetic in character.
E. H. B.

1639. *Kathodic Phosphorescence of Complex Systems. Paralysing Action of certain Rare Earth Excitants on other similar Excitants.* **G. Urbain and C. Scal.** (Comptes Rendus, 144. pp. 1363–1366, June 17, 1907.)—In order to explain the phosphorescence phenomena exhibited by chlorophane [see Abstracts Nos. 641, 642 (1907)], the authors investigate phosphorescing systems containing, as active substance, a binary mixture of black praseodymium oxide or terbium oxide and another rare earth (white) and, as diluent, lime. The presence of coloured oxides of terbium or praseodymium depresses the phosphorescence produced by the other oxides, whilst, on the other hand, the phosphorescence caused by praseodymium oxide is masked, though only to a small extent, by samarium oxide or dysprosium oxide. The practically white salts of praseodymium cause absolutely no masking of the phosphorescence of samarium, terbium, or dysprosium, but salts of samarium or terbium annul almost completely the phosphorescence of praseodymium oxide. These results explain the phosphorescence phenomena of chlorophane. A product exhibiting the exact phosphorescence spectrum of chlorophane can be prepared by adding to lime a few per cent. of the crude mixture of rare earths extracted from gadolinite and containing much praseodymium, neodymium and erbium, and a little terbium and dysprosium, and then converting the whole into fluorides. T. H. P.

1640. *Some Problems in Radio-activity.* **H. Greinacher.** (Naturw. Runds. 21. pp. 671–674, 1906. Chem. Zentralblatt, 1. p. 529, 1907. Abstract.)—The author has employed Lilienfeld's spectroscopic method to determine whether polonium (obtained from Marckwald) contains helium. This gas did not, however, appear to be present, although it is commonly supposed that each α-particle forms an atom of helium. It is considered possible that only the emanations undergo this change, and that the solid elements are not affected. The fact that polonium sublimes above 600° C. renders it, in the author's opinion, of interest to examine the spectrum obtained when polonium is evaporated in an exhausted quartz tube. The activity of other elements is also discussed. L. H. W.

1641. *Radium Emanation.* **W. Ramsay.** (Nature, 76. p. 269, July 18, 1907.)—The author and Soddy showed that the spontaneous change of the emanation from radium results in the formation of helium [Abstracts Nos. 1985 and 2558 (1904)]. When, however, the emanation is in contact with, and dissolved in water, the inert gas produced by its change consists mainly of neon, only a trace of helium being detectable. When the emanation is left in contact with copper sulphate or nitrate solution, the main product of the change is argon, perhaps a trace of neon being also formed, but no helium. Spectroscopic examination of the residue, after removal of the copper from the solution, renders evident sodium and calcium spectra and, very faintly, the red lithium line. Control solutions of copper nitrate, not exposed to the emanation, show no trace of lithium. Thus the gases formed by the degradation of radium emanation belong to the same group of elements as the emanation itself, and it appears as if copper also undergoes degradation, yielding one or more of the lower metals of the copper group. T. H. P.

1642. *Relation between Uranium and Radium.* **F. Soddy** and **T. D. Mackenzie.** (Phil. Mag. 14. pp. 272–295, Aug., 1907.)—The first part of the paper summarises what has been done to show the production of radium from uranium. In the old experiments of Soddy the uranium was freed from radium by repeated precipitation of barium as sulphate. After 550 days the radium content had increased a hundredfold, but was still much less than was expected theoretically, this being probably due to the formation of intermediate products. According to the process of purification initially adopted these intermediate products may or may not be removed; a new method of purification has now been used, viz., the solution of uranyl nitrate in ether. The first experiments started in Oct., 1905; the results on this sample of uranium up-to-date show that the amount of radium produced in 600 days by 250 gm. of uranium is too small to be sure of. In another experiment the gases from the solutions are being stored and tested in case a rayless change intervenes. A third experiment leaves it doubtful whether radium has been produced in a quantity of UrX; further time is required. Other experiments show that the residual activity of actinium is not due to radium. The paper is rather a description of experiments that are in progress than of results attained. R. S. W.

1643. *Radio-active Lead; Isolation of Radium D.* **K. A. Hofmann** and **V. Wölfl.** (Ber. Deut. Chem. Gesell. 40. pp. 2425–2430, 1907. Chem. News, 96. pp. 13–14, July 12, 1907.)—Several methods have been discovered by means of which the separation, to a greater or less extent, of radium D can be effected. One method by which a partial separation results consists in the distillation of the active lead chloride in presence of ammonium chloride; the ordinary lead chloride is less volatile than either RaF, RaE, or RaD, and the distillate can be freed from RaF and RaE by repeated crystallisation from strong HCl in which RaD is least soluble. These least soluble portions are further purified by precipitation from aqueous solution by H_2S; the precipitate at first is almost inactive, but an α- and β-activity is gradually developed which much exceeds that of the original material. When an acetate or nitrate solution is electrolysed, with mercury as kathode, the RaD is concentrated on the kathode. Some of this, in the form of sulphate, placed in an exhausted capillary tube for several months, gave the He lines $\lambda = 587{\cdot}5$, $\lambda = 501{\cdot}6$, $\lambda = 447{\cdot}1$; with RaE and RaF the results were only negative. In no case was any radium emanation obtained. The active lead chloride was heated with zinc and silver with the same end in view, but none of these methods appeared to effect a complete isolation of RaD. Finally, it was found that when magnesium phenyl bromide is allowed to act on lead chloride, lead tetraphenyl is produced, whilst one-half of the lead separates as metallic Pb. If, then, the lead chloride used for this is rich in RaD, most of the RaD will be found in the metallic Pb which separates out, and only a small part in the lead tetraphenyl. L. H. W.

1644. *Radio-active Lead.* **J. C. McLennan.** (Nature, 76. p. 248, July 11, 1907. Phys. Zeitschr. 8. p. 556, Sept. 1, 1907. Translation.)—The difference between the natural ionisation in air observed with an aluminium cylinder, viz., 15 ions per c.cm. per sec., and that found with the least active lead (28 ions), can be wholly explained by differences in the secondary radiation existing in the two metals. The high activity usually observed with lead is due to the presence of active impurities in it (such as Elster and Geitel's RaF), and not to any intrinsic activity possessed by the metal. E. E. F.

1645. *Absorption of α-Rays in Metals.* **E. Meyer.** (Phys. Zeitschr. 8. pp. 425–430, July 1, 1907. Physikal. Inst. d. Univ. Berlin, May, 1907. Écl. Électr. 52. pp. 125–127, July 27, 1907.)—The author quotes additional experiments and arguments to show that in dealing with the absorption of α-rays in metals it is not necessary to assume a diffusion of the rays in them. The absorption of two pieces of metal-foil may be calculated if we know for each sheet the relation between the absorption and the velocity of the rays, *i.e.*, between absorption and the distance between the metal and the source.

E. E. F.

1646. *Scattering of the α-Rays.* **L. Meitner.** (Phys. Zeitschr. 8. pp. 489–491, Aug. 1, 1907.)—When a metal sheet is placed in the path of a beam of α-rays, the decrease in the ionisation which is produced in the gas behind the sheet is attributed by different authors to one of two causes; either a change in the range of the α-particles or a scattering of the rays. The present paper attempts to decide which is the true explanation. Two thick metal sheets have each a hole bored in them, and are then placed a short distance apart, so that the centres of the circular apertures are on the same straight line. The ionisation, J_1, is measured behind the first sheet and also J_2, the ionisation behind both, when a source of α-rays is placed in front of the apertures. For a constant distance apart of the sheets J_1/J_2 must be constant if no scattering is present. The aperture through which the rays first pass is now covered with a thin metal sheet. J_1 and J_2 are now reduced, but their ratio is unaltered if no scattering is present, but if scattering occurs J_1/J_2 is different when the thin metal sheet is present. From his experiments the author concludes that this scattering does take place, and depends on the atomic weight of the metal.

R. S. W.

1647. *Radiation from Thorium Products.* **O. Hahn.** (Ber. Deut. Chem. Gesell. 40. pp. 3304–3308, 1907. Chem. News, 96. pp. 74–75, Aug. 16, 1907.)—The author has already announced the discovery of a new product between thorium and radio-thorium, which, unlike the latter, emits no α-rays but has a longer life [Abstract No. 1009 (1907)]. Further experiments have now confirmed the existence of this intermediate product, for which the name meso-thorium is proposed. It has been shown that in the technical preparation of thorium nitrate the meso-thorium is separated from the thorium, but not so the radio-thorium. If the activity of this thorium is measured over long intervals, different results are obtained according as the α-radiation, the emanation, or the β-radiation is used. Hence it is concluded that, besides radio-thorium and its derivatives, the first members of the thorium series also emit rays. It is known that α-rays are emitted by radio-thorium, ThX, Th emanation, and ThB; the last giving two sorts. It is now shown that thorium itself emits α-rays. The methods are indirect, and are here only briefly indicated; they are: (1) by comparison of the activities of thorium preparations of different ages by the effect of α-rays and of the emanation; (2) making thorium preparations of different age from ThX; (3) preparation of radio-thorium free from ThX. In (1) the differences in the effect of the emanation are greater than those of α-rays, as the activity of thorium itself is added as a constant quantity to the α-ray but not to the emanation measurements. In (3) the inseparable α-activity is smaller than in any ordinary thorium preparation, as the activity of the true thorium is removed. Meso-thorium has been separated from the old thorium preparations, which showed itself by the continual increase of activity and power of emanation. This preparation shows a much stronger β-ray activity than either radio-thorium or thorium under the same conditions of emanation. The full numerical results are to be given later. The following is a list brought up-to-date of the different thorium products in order of formation, with the rays they emit: Thorium, α-rays; Meso-thorium, β-rays; Radio-thorium, α-rays; ThoriumX, α-rays; Emanation, α-rays; ThA, slow β-rays (which may be δ-rays and are but little more penetrating than α-rays); ThB and ThC (both), α-, β-, and γ-rays. R. S. W.

1648. *Radio-activity of Thorium Salts.* **B. B. Boltwood.** (Amer. Journ. Sci. 24. pp. 93–100, Aug., 1907.)—Previous experiments have shown that the activity corresponding to 1 gm. of thorium in a mineral is the same for different minerals. This the author calls the specific activity of thorium. Measurements were also made some years ago of the activity of some samples of thorium oxide prepared by the Welsbach Company. The activity of these was much less than normal. These samples have been preserved, and in the light of Hahn's recent work [see preceding Abstract] on meso-thorium their activities have been redetermined recently. In every case a decrease is found, and this is less than would be expected taking Blanc's value for the half-value period of radio-thorium as 737 days. These results are explained now that meso-thorium is known, and support Hahn's work on that substance. Several old ThX residues have also been re-examined, and owing to the presence of meso-thorium, and consequent production of radio-thorium, the activities have enormously increased. It is shown that in the precipitation of thorium as hydroxide from a solution of the nitrate, meso-thorium is separated from the thorium. R. S. W.

1649. *Origin of the Gases evolved by Mineral Springs.* **R. J. Strutt.** (Roy. Soc., Proc. Ser. A. 79. pp. 436–439, Aug. 2, 1907.)—The gases given off by thermal springs such as that at Bath were compared with those obtained from various specimens of rock. The inert residue from the evolved gases (after they were exploded with oxygen and treated with caustic potash) was measured and examined. This residue consisted chiefly of nitrogen; argon and helium were also present with traces of neon. The following is the comparison for two typical rocks and the Bath spring (the nitrogen from the rocks was removed by sparking):—

Gas.	Argon.	Helium.	Neon.
Bath Spring............	1·5 per cent.	0·12 per cent.	traces
Matopo granite	1·27 „	0·86 „	traces
Syenite, Mt. Sorrel ...	0·29 „	0·11 „	traces

These figures show that there is a general resemblance between the gases of mineral springs and the gases of rocks, so far as nitrogen and the other inert constituents are concerned. It appears that the disintegration and partial solution of ordinary rocks by water at a high temperature accounts for the gaseous as well as the solid products delivered by springs such as those of Bath. It seems probable that the helium of rocks is related to the radium they contain. On the examination of certain modern lavas from Vesuvius the presence of helium was detected in each case. [See also Abstracts Nos. 1285 and 1877 (1906).] J. J. S.

1650. *Decay Products of Emanium (Actinium).* **F. Giesel.** (Ber. Deut. Chem. Gesell. 40. pp. 3011–3015, 1907. Chem. News, 96. pp. 73–74, Aug. 16, 1907.)—From its chemical reactions it is probable that radio-actinium belongs to the alkaline earths, or is closely allied to them. It is known that if finely-divided sulphur be produced in a solution containing radio-actinium this substance is precipitated; this may be due to the simultaneous formation of sulphuric acid. Sulphuric acid can be used to separate radio-actinium and actinium X; the latter remains in solution. In order to test Boltwood's statement that Ac produces Ra, a strong HCl solution was made of some Ac which was four years old. Sulphuric acid is added; the radium which has been produced in the four years should then be found in the precipitate. The activity of this small precipitate does not increase, as is the case with Ra, but decreases at the rate characteristic of radio-actinium. It also gives off an emanation which is neither radium nor actinium emanation. What product this arises from has not yet been determined. Two years ago ½ gm. of emanium was enclosed in a tube out of which the air was then pumped. No helium could be detected in the spectrum; now, after heating, the D_3 line can be seen, thus supporting the work of Debierne. R. S. W.

1651. *Emanation from Radium Salts at different Temperatures.* **L. Kolowrat.** (Comptes Rendus, 145. pp. 425–428, Aug. 19, 1907.)—Although the quantity of emanation produced by a radium salt in solution is constant, the amount that escapes when the salt is solid is variable and depends on the temperature. The latter quantity is the subject of the present investigation. The salt is placed in a platinum tube which, in turn, is in a quartz tube, and the whole is placed in an electric furnace. The temperature is read by a thermo-couple, and the quantity of emanation produced is tested electrically. The chief results are the following: (1) When the salt is fused all the accumulated emanation is set free. (2) The quantity which escapes per sec. at ordinary temperatures is 1 per cent. of the quantity actually produced; this holds up to 850°. It then rises to 90 per cent. at 880°, afterwards decreases to 60 per cent. at 920°, rising brusquely to 100 per cent. at the fusing-point, 945°. Chloride and fluoride both show this anomalous behaviour. R. S. W.

1652. *Origin of Radium.* **B. B. Boltwood.** (Nature, 76. p. 298, July 25, 1907.)—A great part of the letter is concerned with personal matters, in reply to Soddy [see Abstract No. 1855 (1907)]. A solution of 100 gm. of purified uranium nitrate, after a period of more than 2½ years, contains less than 10^{-11} gm. of radium. The only evidence we now have that radium is a disintegration product of uranium is the constancy of the ratio between the quantities of these two elements in the natural minerals. R. S. W.

REFERENCE.

1653. *Literature of the n-Rays, n_1-Rays, Physiological Rays, and the Heavy Emissions.* **G. F. Stradling.** (Frank. Inst., Journ. 164. pp. 57–74, July; 113–130, Aug., and pp. 177–199, Sept., 1907.)—A brief *résumé* of the contents of the original papers is given and a list of references to 278 articles dealing with the subject.

HEAT.

1654. *Melting-points of Tantalum and Tungsten.* **C. W. Waidner and G. K. Burgess.** (Soc. Franç. Phys., Bull. 2. pp. 200–204, 1907. Journ. de Physique, 6. pp. 830–834, Oct., 1907.)—The testing points for the thermometric scale from 0° to 1,200° C. are given by (1) the melting-point of zinc, 419°; (2) of antimony, 630·5°; and (3) of copper, 1,084°. The temperatures given by both the gas-thermometer and the Pt-Rh thermo-couple agree at these points. Above 1,200° extrapolation is necessary. The authors employ the law of Wien, connecting the temperature with the intensity of the light emitted, and a Holborn-Kurlbaum optical pyrometer. They find that in the calibrated portion of the thermometric scale Wien's law is much more accurate than the empirical parabolic law generally employed. They have previously found [see Abstract No. 1362 (1907)] that the melting-points of palladium and platinum are 1,546° and 1,753°. Applying similar methods and making ingenious corrections for the deterioration and the selective radiation of the metal filaments tested, they find that the melting-point of tungsten is 3,080° and of tantalum 2,910°. They have also found that from 0° to 2,000° the resistance of a tungsten filament is given by $R_t = R_0 (1 + 0{\cdot}0039t + 0{\cdot}0_511t^2)$, and for tantalum $R_t = R_0 (1 + 0{\cdot}0027t)$. The tantalum was supplied by Siemens and Halske, and the value of the temperature-coefficient seems to indicate that the purity of the metal was not equal to that of the samples of tungsten tested. [See Abstract No. 956B (1907).]

A. R.

1655. *Thorium-Cerium Mixtures.* **R. J. Meyer and A. Anschütz.** (Ber. Deut. Chem. Gesell. 40. pp. 2639–2647, 1907. Chem. News, 96. p. 24, July 12, 1907.)—An incandescent mantle of pure ThO_2 is not luminous because it is transparent to almost all wave-lengths. Addition of coloured CeO_2 increases the luminous effect up to 1 per cent. only; beyond this point the emission in the infra-red lowers the temperature of the mantle to such an extent as to diminish the luminous radiation. It was found that homogeneous mixtures of ThO_2 and CeO_2 could be prepared up to 7 per cent., but that a part of the cerium had lost its power to oxidise hydriodic acid. It is uncertain whether the limit of 7 per cent. CeO_2 represents a definite compound: in all probability it may be merely a solubility limit.

T. M. L.

1656. *Density and Specific Heat of some Iron Alloys.* **W. Brown.** (Roy. Dublin Soc., Trans. 9. 6. pp. 59–84, Aug. 23, 1907.)—Carbon up to about 0·2 per cent. increases the specific volume of iron 0·0018 c.cm. per 1 per cent. carbon, and up to 1·25 per cent. carbon at the rate of 0·0015 c.cm. per 1 per cent. carbon. Carbon increases the specific heat by 0·0089 per 1 per cent. C. Mn up to about 2 per cent. increases the sp. vol. by about 0·00026 c.cm. per 1 per cent. Mn; and up to 18·5 per cent. Mn it is decreased by 0·00015 c.cm. per 1 per cent. Mn. Mn up to about 18 per cent. increases the sp. heat by 0·0006 per 1 per cent. Mn. Ni up to 20 per cent. has no effect on the sp. vol.; from 20 to 31·4 per cent. it decreases the sp. vol. 0·00028 c.cm. per 1 per cent. Ni. Ni up to 4 per cent. increases the sp. heat about 0·0088 per 1 per cent. Ni; further additions up to 20 per cent. Ni have little effect; between 20 and 31 per cent. Ni there is an increase of about 0·005. Tungsten up to 15 per cent. decreases the sp. vol. by 0·0009 c.cm. per 1 per cent W; up to 1 per cent., W increases the sp. heat 0·0028 per 1 per cent. W; this increase is entirely lost when 8·5 per cent. W is present; further increase of W to 15·5 per cent. is accompanied by further decrease of sp. heat by 0·0098. Si up to 5·5 per cent. increases the sp. vol. 0·0011 c.cm. per 1 per cent. Si; up to 2 per cent., Si increases the sp. heat 0·008 per 1 per cent. Si, but further additions have no effect. Cr up to 8 per cent. increases the sp. vol. 0·00084 c.cm. per 1 per cent. Cr; further addition up to 9·5 per cent. is without effect. Cu up to 1·5 per cent. decreases the sp. vol. 0·0005 c.cm. per 1 per cent. Cu; further addition, up to 4 per cent., is without effect. Co up to 7 per cent. decreases the sp. vol. 0·0001 c.cm. per 1 per cent. Co. Cr, Cu, and Co, in the presence of considerable carbon affect the sp. heat very little. Al up to 4·5 per cent. increases the sp. vol. 0·0025 c.cm. per 1 per cent. Al; up to 8 per cent. Al has no effect on sp. heat. The observations were all made after the specimens had been quenched in water from a bright red heat. The results are applied in a note on hysteresis loss; the advantage of high Si is apparent. [See also Abstract No. 2499B (1904).] F. R.

1657. *Condensation of Moisture on Solid Surfaces.* **F. T. Trouton.** (Chem. News, 96. pp. 92–93, Aug. 23, 1907. Paper read before the British Assoc. at Leicester.)—There are two possible modes in which condensed water vapour on solid surfaces can exist and be in equilibrium with a given vapour pressure. Condensation on a surface brought into a moist atmosphere depends on its previous history. If the surface has been dried at a high temperature with phosphorus pentoxide the amount of moisture is relatively small, and is said to be of the *a* type, but if the drying has been effected only at ordinary temperatures there is considerably greater condensation, called the *b* type. In the latter case there is still probably some of the liquid on the surface affording a nucleus for further condensation; while in the former case the condensation is more analogous to the supersaturated state which can occur when a vapour is compressed along an isothermal in the absence of the nuclei necessary for condensation. When a completely dried surface of glass is placed in an atmosphere of which the moisture is gradually increased up from zero, at first very little moisture condenses compared to that which takes place if the drying has been incomplete, but on reaching a certain critical vapour-pressure the condensation is very rapid, and is now of the *b* type. The electrical conductivity of these two types of condensed surface layers is very different. A comparative experiment was made in which two rods of glass were laid from earth to the knobs of two electroscopes passed up for the purpose into a vessel in which the percentage of moisture could be changed at will. One of these rods was dried by heating while the other was not. As the percentage of moisture was increased the air-dried rod was observed to gradually acquire considerable conducting powers, but the other rod did not conduct until the critical pressure was reached, when it did so suddenly. The critical pressure for glass is roughly 50 per cent. saturation, the same as that found by the deposition method. In the case of shellac, the critical pressure was found to be above 90 per cent. J. J. S.

1658. *Prevention of Accidents with Compressed Oxygen.* **G. Claude.** (Comptes Rendus, 145. pp. 387–389, Aug. 12, 1907.)—In using oxygen cylinders fitted with the usual type of automatic control valve, there is sometimes an explosion, accompanied by flames, upon opening the valve. It is pointed out that the cause is the rapid compression of gas in the narrow passage of the control, which is terminated by an ebonite plug; the pressure at this end may become much higher than the initial pressure in the cylinder, the temperature being correspondingly raised. The ebonite burns, gas escapes, and in one case at least the steel cylinder also continued to burn in the escaping oxygen. By adding a further short length of passage so that the ebonite plug is not at the end of the *cul-de-sac*, the author states that risk is avoided. A pressure gauge may also be attached to the end of this fitting, which in the case of a specimen exhibited only occupied a space of 1 cm.^{3}. F. R.

1659. *Absorption of Gases by Charcoal.* **Miss I. F. Homfray.** (Chem. News, 96. p. 93, Aug. 23, 1907. Paper read before the British Assoc. at Leicester.)—Experiments were made on the absorption of argon by charcoal. The apparatus used was similar to a constant-volume gas thermometer, the bulb containing 3 gm. of charcoal. In Bertrand's vapour-pressure formula $P = G[(T - a)/T]^n$ values of the constants a and G were calculated for each concentration as well as for argon vapour itself. The logarithms of the concentrations were plotted against values of a and G respectively, and a smooth curve was obtained terminating at 100 per cent. in the constants for argon. Equations were then obtained which express with considerable accuracy these curves, and when introduced into Bertrand's equation the corresponding temperatures or pressures calculated for any concentration are in very fair agreement with those experimentally found, except for exceedingly small concentrations. These equations are—

$$a = 18{\cdot}12 + \frac{250}{24}[\log(100/C)]$$

$$\log g = 0{\cdot}1085 - 0{\cdot}012[\log 100/(C + 1)],$$

where $g = (G)^{\frac{1}{36}}$. The values 18·12 and 0·1085 are the values respectively of a and $\log g$ for argon vapour. The equations given agree better with observation than the logarithmic or exponential equations usually employed to express the isotherms. J. J. S.

1660. *Compressibility of Gases under Pressures near that of the Atmosphere.* **D. Berthelot.** (Comptes Rendus, 145. pp. 317–320, July 29, 1907.)—The author finds that for pressures below 2 and even below 1 atmo. the variation of pv is not a linear function of the pressure for highly compressible gases. The results obtained with carbon dioxide, nitrous oxide, and sulphur dioxide under pressures varying from 0·25 to 2 atmos. indicate that the variation of pv is a linear function of the density. The bearing of this result on those previously obtained is discussed. T. H. P.

1661. *Atomic Energy of Gases.* **H. Crompton.** (Zeitschr. Phys. Chem. 59. pp. 635–637, June 28, 1907. From the English.)—The ratio of the energy of a single atom to the molecular energy may be calculated from either of the expressions: $\lambda = (C_p - 5)/3n = (C_v - 3)/3n$, C_p and C_v being the molecular heat of the gas at constant pressure and volume respectively, and n the number of atoms in a molecule. The mean kinetic energy of an atom within the molecule being less than that of the whole molecule, the value of λ must be less than unity. But when calculated from the above formulæ, the value of λ for certain substances is found to be greater than 1. Ensrud [Abstract No. 784 (1907)] attributes this discordance to the incomplete vaporisation of the substances, but the author shows that it may also be accounted for by the variation of the specific heat of the gas with the temperature. T. H. P.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1662. *Theory of Metallic Conductivity.* **J. J. Thomson.** (Inst. Elect. Engin., Journ. 38. pp. 455–465; Discussion, pp. 465–468, June, 1907. Electrician, 58. pp. 839–841, March 15, 1907. Écl. Électr. 51. pp. 21–23, April 6; 94–95, April 20; and pp. 127–129, April 27, 1907.)—The author summarises the "corpuscular" or electron theory of metallic conduction and indicates a few modifications of it which have become necessary in the light of recent observations. The theory may be stated as follows: "By the action of one atom of the metal on another, corpuscles are split off from the atoms, and they remain diffused through the mass of metal; so that we may picture to ourselves a metal as somewhat like a porous body, the pores of which are occupied by a substance with the properties of a perfect gas. In the older theory it was supposed that these corpuscles remained free for a time sufficiently long to enable them to get in thermal equilibrium with the metal itself, so that, like all gases, the average kinetic energy of the corpuscle was a constant merely depending upon the temperature." The modification now required is to suppose that the electric force, instead of acting on the corpuscles after they have left their atoms, really acts upon the atoms before the corpuscles leave them. The atoms probably act on each other like a system of electric doublets, and the electron flows from the negative end of one doublet into the positive end of another. This modification is based upon the experiments of Rubens and Hagen on the conductivity of metals under very rapidly alternating electric forces of the order of light-waves, which is practically the same as that for steady currents. To give this conductivity, the number of corpuscles per c.cm. would have to be $1{\cdot}8 + 10^{24}$ in the case of silver. The author states the difficulty thus arising as follows: "We require that number of corpuscles per c.cm. to give, in the time deduced from the experiments of Rubens and Hagen, the proper electrical conductivity of silver. Now, you have that number, each possessing at the absolute temperature θ an amount of kinetic energy $a\theta$, and therefore to raise the temperature 1° you would have to give to each one of these an amount of energy a, or to the whole lot an amount of energy represented by $a \times 1{\cdot}8 \times 10^{24}$, a being about $1{\cdot}5 \times 10^{-16}$; so that this energy is $1{\cdot}9 \times 1{\cdot}5 \times 10^{8}$ ergs, that is, somewhere about 7 cals. is required to raise 1 c.cm. of silver 1° C. if you leave the atoms of silver alone and merely attend to the corpuscles. The actual amount required to raise the temperature of the silver is only about 0·6 cal., so that there is a serious discrepancy between the results of the theory in this form and the results of experiments on specific heat." The difficulty may be got rid of by supposing that the electron, instead of wandering about, jumps practically straight from one atom into another. As regards the outstanding difficulty of the Hall-effect, this is dealt with by the author as follows: "Suppose that we have a doublet with negative and positive ends, then if it is pulled round by an electric force, the ends start moving, one in one direction and the other in the opposite, and if there is a magnetic force acting upon the thing at right angles to the plane of motion, then there will be forces acting upon these two ends. If the ends move with equal and opposite velocities, the forces on the two ends are equal; but if the velocities are different, then the forces on the ends are different and there is a couple produced—in fact, the doublet when placed in a magnetic field behaves exactly like a gyroscope. Suppose we have a pendulum with a gyroscope bob instead of the ordinary bob; suppose it were held away from the vertical, corresponding to one of our doublets before an electric force acts; supposing, now, it is let fall; gravity, instead of pulling it straight down to the vertical, will make it swing round like a gyroscopic pendulum one way or the other, according to the direction of the spin in the top in the bob. So that if this gyroscope property were attached to a doublet, then when there is an attempt to pull it along the lines of electric force it will come out a little at right angles, and there will be a current either that way or the other way, according to the sign corresponding to the spin of the top of the gyroscope. So that, in addition to the movement along the direction of the line of force, the doublets would tilt up a little bit at right angles to it; there would be a polarisation in the direction of right angles to it, and that polarisation would produce a current in that direction, so that unless the negative and positive ends move with equal and opposite velocities—that is, unless the centre of gravity of the doublet is exactly midway between the negative and positive charge—then these doublets when they are placed in a magnetic field will be acting like gyroscopes, and if it is attempted to pull them by a force in one direction they tend to squirm off in a direction at right angles to it; and that, I think, accounts for the Hall-effect in metals." In the course of the *discussion*, **S. P. Thompson** asked why the author used the word "corpuscle" instead of "electron." The **Author** replied that he preferred a word which could not be mistaken for the name of any "positive" electron. The corpuscle was always understood to be a negative electron. E. E. F.

1663. *Range of Freedom of Electrons in Metals.* **J. Larmor.** (Phil. Mag. 14. pp. 312–316, Aug., 1907.)—The experiments of Hagen and Rubens on the reflection of heat rays from metals show that for waves of period about 10 times that of light-waves the reflecting power is determined by the ohmic conductivities of the metals. For that type of radiation the square of the quasi-index of refraction is therefore a pure imaginary quantity. The case considered here relates to radiation of periods which are very rapid compared with the times of undisturbed motion of the electrons. It is shown that if the electrons are free the square of the quasi-index must be a real negative quantity. The optical determinations of Drude indicate that this is not far from being true with light-waves for some of the nobler metals. Calculation shows that $\mu^2 = -N' \times 2 \times 10^{-22}$, where $N' =$ number of electrons per c.cm. For the nobler metals, in red and yellow light, the real part of μ^2 is of the order -10, giving $N' = \frac{1}{2} \times 10^{23}$, about the same order as that of the molecules of the metal per c.cm. One view of metallic conduction is that it takes place by free electrons whose velocities are prescribed by collisions with the molecules. It is calculated that the mean free paths must not exceed 10^{-8} cm.; their excursions must, in fact, be largely confined to the spaces between the molecules. R. S. W.

1664. *Theories of the Electron.* **M. Planck.** (Deutsch. Phys. Gesell., Verh. 9. 14. pp. 301–305, July 30, 1907.)—It is pointed out that before Kaufmann's results on the magnetic and electrostatic deflection of β-rays can be used to decide between the two theories of the electron—the undeformable spherical electron of Abraham or the deformable electron of Lorentz—they must probably be freed from a source of experimental error. Kaufmann assumed that the fall of potential between the condenser plates was uniform, while according to some experiments of Wehnelt, quoted by the author, this is not the case. Approximate calculations have been made which show that it is possible the theory of Lorentz would better explain the experimental results. [See also Abstract No. 2057 (1906).] R. S. W.

1665. *Lightning.* **C. P. Steinmetz.** (Elect. Rev., N.Y. 51. pp. 167–169, Aug. 3, 1907. From an address delivered before the National Electric Light Assoc., June 15, 1907.)—An estimate of the voltage of a lightning-flash from its length and the disruptive potential gradient of the air leads to values which are impossibly high. More reasonable values are obtained by other methods. A lightning discharge does not take place suddenly, in a single flash, but by a succession of discharges, the initial discharge occurring in that part of the cloud where the potential gradient is steepest. This initial discharge increases the steepness of the gradient in the remaining portions of the cloud, thereby producing a succession of discharges. The production of a non-uniform potential gradient is easily accounted for by the uneven condensation which takes place during the formation of the cloud. Assuming condensation to commence at a uniform rate, we have a series of small spherical drops, each at a potential corresponding to that of the air in which they float. The drops coalesce to form larger ones, and since the total charge of a large drop will increase in proportion to the cube of its diam., while its capacity will only increase in proportion to the diam., it follows that the potential of a drop will increase as the square of its diam. With uneven condensation very large differences of potential may thus be brought about between different portions of the same cloud (or between two clouds, or a cloud and the earth). Estimating the average size of the drops at 10^{-4} in. at the beginning of coalescence, and the initial potential gradient at 100 volts per ft., a gradient of between 10^6 and 2×10^6 volts/ft. (corresponding to disruptive strength of air) would be reached when the drops have reached a diam. of 0·1 and 0·2 in. respectively—*i.e.*, when they have reached the size of rain-drops. An estimate of the potential gradient may also be formed from the luminosity and duration of the discharge. The final results arrived at by the author are as follows: Average potential gradient at moment of discharge, 50,000 volts/ft.; average current, 10,000 amps.; average duration of discharge, 2×10^{-6} sec.; average frequency of discharge, 500,000. A. H.

1666. *Heating of a Balloon Wire by Lightning.* **E. Gold.** (Nature, 76. pp. 413–414, Aug. 22, 1907.)—A captive balloon held by 4,500 ft. of No. 19 S.W.G. tinned piano-wire was struck by lightning in the form of a cross flash from the cloud. The heat developed appears to have been sufficient to melt the tin but not to fuse the wire. If it is assumed that the process is too rapid for loss of heat by conduction the heat energy must be between the limits $6 \times 1400 \times 200 \times 0{\cdot}11$ and $6 \times 1400 \times 1300 \times 0{\cdot}18$ in gm.-cals., the wire weighing about 6 gm. per m. and the mean specific heat of steel from 0° to 1,300° C. being taken to be 0·18. In ergs the limits are $7{\cdot}12 \times 10^{12}$ and $8{\cdot}28 \times 10^{13}$, or assuming the height of the cloud to be 100 m., the energy was sufficient to raise 73 kg. but not sufficient to raise 840 kg. to the cloud level. J. J. S.

1667. *Ionisation in Closed Vessels.* **W. W. Strong.** (Science, 26. pp. 52–53, July 12, 1907.)—A record of the daily variation of ionisation with special reference to the periods of maxima and minima in Baltimore. In Feb. and March maxima were found to occur at about 9 a.m. and 10 p.m., and minima at about 7 a.m. and 6 p.m. The most conspicuous is the minimum at 6 p.m. This occurs with considerable regularity and is very marked, the ionisation often falling 30 or 40 per cent. No corresponding change of temperature or barometric pressure was noticed. It never drops below the value of the ionisation when the penetrating radiation is cut off. On screening the electroscope used to make the observations with lead plates 4 to 5 cm. thick the rate of leak was made much more constant. The marked minimum at 6 p.m. was usually not noticeable. J. J. S.

DISCHARGE AND OSCILLATIONS.

1668. *Ionisation by Bubbling.* **M. de Broglie.** (Comptes Rendus, 145. pp. 172–173, July 16, 1907.)—The intensity of ionisation depends greatly upon the size of the orifice. Feeble for capillary tubes, it passes through a maximum, and becomes very feeble again for large diameters. If aspiration takes place through a bubbler with a fine tube open to the atmosphere, and the depression is varied, the current indicated by the electrometer varies slowly at first, and then in proportion to the difference of pressure. Adding different salts such as NaCl, KCl, KI, $BaCl_2$ gradually, and tracing curves with concentrations as abscissæ and currents as ordinates, it is found that with positive charges the ionisation, very feeble at first, rises rapidly, passes through a flat maximum for about millinormal concentration, and then tends to a constant value. For negative charges the maximum is more decided, and occurs at 1/2000 normal; the curve then falls, cuts the former curve at 1/100 normal [1/106 erroneously given in original. See *Erratum,* ibid. p. 292] under an acute angle, and then falls slowly. It follows that the total charge is negative at first, then zero, and finally positive. Dilute solutions of HCl, H_2SO_4, KOH, NaOH, and acetic acid show the same general behaviour. In the first (rising) branch of each curve the sensitiveness for very slight variations of concentration is very great. Adding alcohol to water there are no maxima at feeble concentrations, but ionisation increases regularly, attains that of pure alcohol at 80 per cent., and then remains steady. By the influence of Röntgen rays or radium rays the gases ionised by bubbling through a salt solution have their conductivity reduced to 1/6 or 1/10. On the other hand, gases bubbled through benzene, toluene, and essence of terebenthine, which are non-conducting, acquire conductivity. They evidently contain neutral centres chargeable by radium rays. The presence of such centres in air before bubbling greatly increases its subsequent ionisation. E. E. F.

1669. *Rays of Positive Electricity.* **J. J. Thomson.** (Phil. Mag. 14. pp. 295–297, Aug., 1907.)—Wien ascribes the constancy of the value of e/m observed for canal rays in different gases to the presence of hydrogen as an impurity in the discharge-tube [see Abstract No. 1558 (1907)]. Thomson considers that this explanation is not adequate, for when the amount of hydrogen present is varied within very wide limits, there is no corresponding variation in the brightness of the parts of the canal rays which are ascribed by Wien to the presence of hydrogen. There are indications that there are other cases besides that of the highly exhausted tube in which the carriers of positive electricity have the constancy characteristic of the canal rays at low pressure. In the case of flames containing salt-vapours, for example, there is evidence that the masses of the carriers in the flame are comparable with those found in the canal rays. J. J. S.

1670. *Velocity of Kathode Particles emitted by Metals.* **P. D. Innes.** (Roy. Soc., Proc. Ser. A. 79. pp. 442–462, Aug. 2, 1907.)—Experiments were made upon the velocity of the kathode rays sent out by various metals when exposed to the action of Röntgen rays, with a view of deciding whether these kathode rays were due to corpuscles shot out from the atom when its energy was increased by the impact of Röntgen rays until a sort of explosion occurred, or whether the emitted particles or kathode rays were due to corpuscles already free in the metal and not bound up in the atoms, being those electrons on which metallic conduction depends. The method used was a photographic one in which the kathode rays were allowed to fall directly on the sensitive plate. Care was taken to obtain regularity and constancy in the rays. A magnetic field was used to deflect the β-particles, and the experiment was carried out *in vacuo*. The following is a summary of the results : (1) The velocity of the electrons emitted by lead, silver, zinc, platinum, and gold under the influence of Röntgen rays was measured both for soft and hard rays, the values found being as given in the following table, where the accuracy is within about 3 per cent. :—

	Soft Rays.	Hard Rays.
Lead	$6{\cdot}3$ to $7{\cdot}6 \times 10^9$	$6{\cdot}3$ to $8{\cdot}3 \times 10^9$
Silver	$6{\cdot}0$ to $7{\cdot}2 \times 10^9$	$6{\cdot}1$ to $8{\cdot}0 \times 10^9$
Zinc	$6{\cdot}0$ to $6{\cdot}4 \times 10^9$	—
Platinum	$6{\cdot}1$ to $7{\cdot}5 \times 10^9$	$6{\cdot}4$ to $8{\cdot}1 \times 10^9$
Gold	$6{\cdot}1$ to $7{\cdot}5 \times 10^9$	$6{\cdot}2$ to $8{\cdot}1 \times 10^9$

(2) The velocity of the fastest electrons emitted from each metal is completely independent of the intensity of the primary rays, but increases with the hardness of the tube. (3) The velocity decreases with the atomic weight, the difference between the speed of the fastest electron with hard rays and that with soft rays being practically the same for the various metals, if the variation in hardness of the rays is the same. (4) A minimum velocity is necessary to enable the electron to emerge, and the minimum velocity is nearly the same in the different metals. (5) The number of electrons given off decreases with decreasing intensity of the rays, as well as with increasing hardness. (6) The number emitted also decreases with decreasing atomic weight and density. (7) The conclusion is drawn from calculation and discussion of other theories that the most probable theory is that of atomic disintegration. It is shown that the velocity of the emitted electron is too great to be that acquired under the influence of the force in the Röntgen-ray pulse. J. J. S.

1671. *Behaviour of Metallic Vapours in the Electric Spark.* **A. Battelli** and **L. Magri.** (Accad. Lincei, Atti, 16. pp. 12–15, July 7, 1907.)—Photographs of the electric spark were obtained by G. A. Hemsalech in which striæ were observable [Abstract No. 1075 (1907)], and he considers that these are due to oscillations which are harmonics of the fundamental. The authors contradict this, and explain the striæ in the light of previous experiments of theirs. [See Abstract No. 1211 (1907).] At each half-oscillation luminous metallic vapour leaves the electrode and travels in the direction of the spark, the luminosity not being dependent upon the current, but persisting after this has fallen to zero. This vapour travels with velocity which depends upon several conditions, and the striæ are, therefore, not uniform. A photograph is given in which the motion of these irregular jets of vapour may be traced. S. G. S.

1672. *Rotation of Electric Discharge in Gases in a Radial Magnetic Field.* **H. A. Wilson** and **G. H. Martyn.** (Roy. Soc., Proc. Ser. A. 79. pp. 417–427, Aug. 2, 1907.)—De La Rive's well-known experiment is here investigated in well-defined conditions. A discharge is sent through the rarefied gas contained in the annular space between two concentric glass tubes by means of a large battery. The discharge is about 8 cm. long; the rotation is produced by an electromagnet lying along the axis of the tubes, and the velocity of rotation is observed by a stroboscopic method. The current, pressure, and velocity of rotation of the discharge are measured for air, hydrogen, and nitrogen under different magnetic fields. As the discharge current is increased the rate of revolution passes through a flat minimum. The velocity is nearly proportional to the magnetic field, and is approximately thirteen times greater in hydrogen than in nitrogen. It is, therefore, inversely as the density of the gas, in all probability. If n is the number of revolutions per sec., p the gas pressure, and H the magnetic field, it is found that np/H is a constant for each gas. A theory of the effect is given for the case of a uniform discharge. H. A. Wilson has previously measured the Hall-effect in gases; if Z is the transverse electric intensity due to this, X the electric intensity in the positive column, supposed uniform, C the current in the discharge tube, and k_1, k_2 the velocities of the positive and negative ions, it is shown that $\mathrm{C} = p \times k_1k_2$, and $2\mathrm{D} = p\mathrm{X}(k_2 - k_1)$, D being a constant obtained from the Hall-effect. From these equations k_1 and k_2 can be found. As an example of the results obtained, for air $k_1 = 450$, $k_2 = 19{,}700$ cm./sec. If we assume that the velocity of the positive ion varies inversely as the pressure, this gives $k_1 = 2{\cdot}2$ cm./sec. at atmospheric pressure. It seems probable, therefore, that k_1p does not vary much with pressure. From the large value of k_2 it seems probable that some of the negative ions are electrons. R. S. W.

1673. *Discharge of Electricity from Hot Bodies.* **G. H. Martyn.** (Phil. Mag. 14. pp. 306–312, Aug., 1907.)—Wilson has shown that the leak from hot platinum is greatly increased by the presence of hydrogen; Wehnelt has shown that a coating of lime has a similar effect. The question investigated here is whether these two effects are independent or not. The discharge is measured from a platinum wire in air, in hydrogen, in air when coated with lime, in hydrogen when coated with lime. The experiments show clearly that the effects of the hydrogen and lime are additive. R. S. W.

1674. *Influence of Temperature upon Photo-electric Effects.* **R. A. Millikan** and **G. Winchester.** (Phil. Mag. 14. pp. 188–210, July, 1907. Paper read before the Amer. Physical Soc., Nov. 30, 1906.)—There are two views as to the mechanism of the discharge of corpuscles from metals under the influence of ultra-violet light. According to the first the discharged particles are the free or "metallic" corpuscles of the body, which, by absorbing the ultra-violet light, acquire sufficient kinetic energy to enable them to escape from the attraction of the metal. According to the second view the escaping electrons are constituents of complex atomic systems which become unstable under the influence of the ultra-violet light, and project electrons from themselves with velocities not greatly different from those which these electrons possessed within the atom. If the first view is correct, the number of corpuscles escaping per sec. will be an increasing function of the temperature, but if the second view is the true one, it is not to be expected that the rate of discharge will depend upon the temperature. The investigation described by the authors was undertaken to decide whether photo-electric effects are or are not dependent upon temperature. The metals experimented upon were placed in very high vacua, because when they are in air or other gases the true photo-electric effects are completely masked by the action of the electrical double-layer which is produced at the surface. The following are the conclusions reached by the authors: (1) The photo-electric discharge from metals is a phenomenon which, like radio-activity, is completely independent of temperature. The escaping electrons are therefore not the free electrons of the metal, but are rather electrons which become detached from the atom because of the coincidence of their own natural periods with the periods of the impressed ether-waves. (2) The positive potentials acquired by the different metals under the influence of ultra-violet light are wholly independent of temperature, and hence temperature-changes produce no change in the velocity of the electron within the atom—a result which is in accord with the known thermal properties of monatomic gases. (3) The order in which metals in a vacuum exhibit photo-electric sensitiveness bears no relation whatever to the Volta contact series. Any apparent relation between the two is probably due to the masking of the true photo-electric effect by the effect of the double-layer formed between the oxygen and the metal. (4) The order in which the metals arrange themselves with respect to the positive potentials assumed in a vacuum under the influence of ultra-violet light bears no relation to the Volta contact series. (5) Clean, unpolished metals exhibit in a vacuum, under the influence of a given source, perfectly definite and constant discharge rates. If fatigue effects occur at all, the recovery from them is complete in the course of a few minutes. J. J. S.

1675. *Photo-electric Fatigue.* **W. Hallwachs.** (Ann. d. Physik, 23. 3. pp. 459–516, July 5, 1907.)—The author has considered this subject in earlier investigations, and has stated his conclusion that the various causes which have been supposed to account for the phenomena, such as oxidation, action of light, corrosion of the surfaces, have no actual influence. Observed facts show that the principal fatigue phenomena in free air are due to the action of ozone. In the earlier portions of the present paper the author gives a summary of the experimental facts that lead him to the conclusion that photo-electric fatigue is not the result of the influence of light or of corrosion, and that it is not due to the formation of electric double-layers. In connection with the latter subject he discusses photo-electric fatigue and contact potential. In the last portion of the paper he describes the action of ozone in connection with the phenomenon. The feeble fatigue in closed vessels may be traced to the increase of electron absorption due to the increase of the gas charge of the plates. The strong fatigue in free space may be similarly explained as caused by the action of ozone in producing absorption of electrons in the gas charge of the plates, this being due to the influence of ozone on the motion of the electrons—strong absorption of slow electrons and eventual lessening of their energy of vibration in the metal. J. J. S.

1676. *Photo-electric Fatigue.* **W. F. Holman.** (Phys. Rev. 25. pp. 81–87, Aug., 1907. Paper read in part before the joint meeting of the Amer. Physical

Soc. and Amer. Assoc. for Advancement of Science, June, 1906.)—The photo-electric current from zinc, carefully polished and cleaned, was observed. As source of illumination an electric arc between steel electrodes in hydrogen was used. The chamber in which the zinc was mounted was evacuated and left at an indefinitely low pressure in connection with a drying chamber for several hours. With a gas pressure of 0·001 mm. the mean value of the photo-electric current was 6×10^{-10} amp. After admitting hydrogen at a pressure of 1·5 mm. a glow current was then sent from the zinc as kathode for about 15 min., and the chamber again evacuated to a pressure less than 0·001 mm. Successive readings of the photo-electric current then gave a mean value of $8{\cdot}8 \times 10^{-10}$ amp. After standing 12 hours the mean value observed was $4{\cdot}1 \times 10^{-10}$ amp. Then hydrogen was again admitted, and the metal used as *anode*, during a period of about 7 min., after which the pressure in the chamber was reduced to less than 0·001 mm. The mean value of the photo-electric current in this case was $5{\cdot}9 \times 10^{-10}$ amp. The results may be explained if it is assumed that hydrogen serves as carrier of negative electricity in the photo-electric current as in Skinner's experiments on the glow current through rarefied gases. [See Abstract No. 1768 (1905).] A similar series of experiments, using electrodes of different metals, gave the following results :—

	Photo-electric Current (10^{-10} Amps.).				
	Zinc.	Copper.	Silver.	Aluminium.	Iron.
After using as kathode with glow current in hydrogen	16	11·6	6·4	0·6	0·6
After standing 12 hours in hydrogen	8·8	1·8	0·6*	0	0
After again using as kathode......	41	16	14*	5	4·5
After using as anode in hydrogen	7	15	6	1·3	1·4
After using as kathode again......	36	16·5	25	2·7	5
After standing in hydrogen several hours	28	9·3	16	2·5	3·2

[* Wrong position in original.]

J. J. S.

1677. *Influence of Temperature on the Light-electric Effect.* **G. Winchester.** (Phys. Rev. 25. pp. 108–114, Aug., 1907.)—Discs of different metals are mounted on a wheel within a vacuum-tube so that they can, in turn, be brought opposite a quartz window through which ultra-violet light is passed. The electrical connections are made by platinum springs and the leak tested by an electrometer. When the vacuum-tube and its contents are placed in an electric furnace the leak at different temperatures may be observed while the gas pressure is so low as to render the influence of the gas negligible. It is found that temperature is nearly without effect on the rate of leak. At temperatures above 100° C. the natural leak of the apparatus, apart from that due to light, becomes unusually large. The cause of this is unknown. In opposition to the results of Elster and Geitel, it is found that those metals with the highest melting-point give the greatest leaks. R. S. W.

1678. *Relation between Intensity of Ultra-violet Light and Quantity of Electricity Discharged from a Zinc Plate.* **I. O. Griffith.** (Phil. Mag. 14.

pp. 297–306, Aug., 1907.)—If I denote intensity of light and E the corresponding photo-electric effect, it is usually supposed that E/I is constant. According to the experiments described in this paper this is by no means the case. The light is produced by a spark between suitable terminals, and its intensity at the surface of the zinc plate is varied by altering the distance. To correct for absorption by the intervening medium, the increased distance is occupied by a tube which can be exhausted, its ends being closed by quartz plates. In all the experiments it is found that E/I increases with I at a gradually increasing rate. As an instance, in one of the experiments, while I varies from unity to 126, E/I varies in the ratio 1 : 2·52. By the same apparatus it is shown that air and hydrogen exhibit marked selective absorption on the light used in the experiments, and Lenard [Abstract No. 1888 (1902)] does not appear to have corrected his results on the same subject for this absorption. **R. S. W.**

1679. *Extra-transmission of Electric Waves.* **W. B. Cartmel.** (Phys. Rev. 25. pp. 64–69, July, 1907.)—The phenomenon of extra-transmission of electric waves was described by F. C. Blake and C. R. Fountain, but since then C. Schaefer has cast doubts upon the existence of the phenomenon [see Abstracts Nos. 100 and 1208 (1907)]. The present author considers that the results obtained by Blake and Fountain are not only reasonable but are precisely what should have been expected. In their experiments they allowed electric waves to fall upon sheets of glass upon which tin-foil strips had been pasted, and also upon sheets of bare glass, and found that when the tin-foil-covered sheets of glass were used, under some circumstances there was less energy reflected and more transmitted than was the case with bare glass. This they accounted for by assuming that glass covered with tin-foil strips constitutes a medium having a different index of refraction than that of glass. To the present author it seems preferable to suppose that since the total energy reflected by bare glass is the vector sum of the amounts reflected by the front and back surfaces of the glass, and since the change of phase produced at a surface on which there are tin-foil strips is different from that produced at a bare glass surface, it might well happen that the tin-foil strips would cause the difference of phase between the energy reflected at the two surfaces to be more favourable to destructive interference, and that there would be a consequent diminution in the reflected intensity and an increase in that transmitted. That such a change of phase is produced by screens of resonators is more than likely, especially in view of the experiments showing such change of phase carried out by Schaefer and Laugwitz [Abstract No. 119 (1907)]. If the above explanation of the phenomenon of extra-transmission be correct, it ought to be possible to obtain the same effect with ordinary light. All that is necessary is a sufficiently thin film of one substance, and upon this a very much thinner film of some other substance, to produce the necessary phase-changes. After unsuccessful endeavours with some substances the following experiment was tried. The author lightly silvered a film of selenium which had been deposited on glass by kathodic discharge. The result was that the film of selenium, which was previously of an orange colour, changed to purple. This would show that there was less purple light reflected after silvering, and hence more transmitted. The film of silver was very thin (deposited in 15 sec. by the kathode discharge), and where it fell on bare glass it was impossible to detect it by the eye. Part of the plate had been protected from the kathode discharge, and the only way in which it was possible to tell where the silver had fallen was by difference in colour of the two parts of the selenium film. Other experiments are described and the theory discussed. Finally, the author disclaims power to judge as to the reasonableness of Schaefer's criticisms, but even if Blake and Fountain's results could be shown in fault, he believes it would be still possible for a true extra-transmission to be obtained. E. H. B.

1680. *Propagation of Electric Waves.* **W. M. M[adden].** (Elect. Rev. 61. pp. 200–208, Aug. 2, 1907.)—The writer criticises destructively the explanations given by Fleming, Vreeland, and others of the propagation of electric waves and the behaviour of "lines of force," and regards the propagation of waves as merely the phenomena attendant on the relaxation of a strain already existing in the medium, apparently assuming an infinite velocity of propagation of the original strain. He summarises his conclusions thus: "There is no evidence of any decussation, snapping off, or nipping off of the collapsing lines of force; nor of their crossing one another. That the collapse is a mathematical fiction convenient for the purpose of calculation; and that to associate the ideas of inertia and energy with it is like talking of the inertia of a column of figures or the toughness of a differential equation. That the origin of an electric wave is the relaxation of the strain in the ether around the oscillator. Too much importance is attached to the current in the oscillator itself, the function of which is to build up the electrostatic field. . . ." In a remark as to the production of waves by currents of low and high frequency, which he illustrates by comparison with the effect of alternating currents on a galvanometer, the author apparently, however, admits the idea of a quasi-inertia. J. E.-M.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1681. *Contraction of a Liquid Conductor carrying a Large Current.* **E. F. Northrup.** (Phys. Rev. 24. pp. 474–497, June, 1907. Paper read before the Amer. Phys. Soc., March 2, 1907. Electrician, 59. pp. 868–872, Sept. 13, 1907. Abstract.)—C. Hering has observed that when a relatively large alternating current passes through a non-electrolytic liquid conductor contained in a trough the liquid gets heaped up at the electrodes, a well-marked depression with steep sides occurring midway between them. In the case of a liquid metal this depression extended as deep as 6 in. With a constant current the condition was stable, but the liquid on the inclined surfaces was strongly agitated. With a still greater increase of current the depression reached the bottom of the trough and so the current was momentarily broken. The liquid flowing together again remakes the current and thus a violent interrupter is formed. Hering suggests that this action may throw light on the blowing of fuse wires and the action of the Caldwell interrupter. As the action of the forces is to squeeze or pinch the conductor, he humorously called it the "pinch phenomenon." The author has repeated Hering's experiments, using mercury as the liquid conductor, and describes an apparatus which shows the effect well with a current of 180 amps. The magnetic field inside a cylindrical conductor carrying a uniform current parallel to its axis is considered. It is shown that if two magnets be placed on a rigid frame with their south poles pointing to the axis of the liquid conductor and their north poles pointing to its circumference, rotation will ensue when a current flows, and a simple apparatus for showing this experiment is described. An expression for the pressure at points inside a liquid conductor carrying a current is found, and an apparatus is described in which a local stream of mercury is kept circulating when a large current is passed through a mercury column. The forces produced by an electric current in a conductor of circular cross-section are compared with the forces produced by gravity in the interior of an infinitely long cylinder of the same radius and section. It is proved that the gravitational attraction is given by an algebraical expression of the same form as that which gives the attraction on unit length of unit current in the liquid conductor. The author describes a heterogeneous conductor ¼ in. in diam. made up of 1,000 cells or mercury sections of 1 mm. length each, whereby a pressure of 48·2 lbs. per sq. in. could be obtained by means of a current of 600 amps., although no iron is used in the construction. This pressure would sustain a column of mercury over 7 ft. high. As the force depends accurately on the square of the current, the effects produced by it may be used to measure the current. Since the forces can be magnified by using iron in the construction, motors without brushes or slip-rings may be built. Further engineering applications in this direction may be anticipated. A. R.

1682. *Mercurous Sulphate and the Cadmium Cell.* **G. A. Hulett.** (Phys. Rev. 25. pp. 16–30, July, 1907. Electrician, 59. pp. 841–844, Sept. 6, 1907.)—From the standpoint of the electrolytic dissociation theory we might expect mercurous sulphate to be less soluble in a cadmium sulphate solution than in water, since the two salts have a common ion. Experimentally, however, the solubility was found to be about five times as great in the former solvent as in water, and this fact suggested that the common ion might be ineffective in preventing hydrolysis of the mercurous sulphate. When the kathode system of a cadmium cell was rotated for about 30 days, the mercurous sulphate was found to behave abnormally: cells set up with it as a depolariser were initially high in e.m.f. but gradually fell below the normal value. Experiments showed that the action was not due to dissolved oxygen in the cadmium sulphate solution and that there must be some interaction between the materials of the kathode limb. Assuming that this action is hydrolysis, it follows that the presence of sulphuric acid, one of the products of hydrolysis, would minimise or prevent the changes, and this was found to be so. The changes which have been observed in the e.m.f. of cadmium cells are, however, very small, the mean e.m.f. of 5 cells set up in Oct., 1905, having fallen by 1·1 parts in 100,000 only in an interval of 18 months. [See also Abstracts Nos. 1277 (1905) and 1905 (1906).] F. E. S.

1683. *The Electro-densimeter.* **L. Benoist.** (Journ. de Physique, 6. pp. 604–615, Aug., 1907.)—A thorough methodical study of the electroscope has been made for the purpose of removing its defects, and a measuring instrument has been devised in which the deflection of the leaf is almost proportional to the potential. The single leaf is chosen as giving a maximum of sensibility, simplicity, and facility of reading. The leaf is made so that it can be removed and again replaced in exactly the same position, and by using leaves of different size, weight, or material the sensibility may be altered at will. The leaf is fixed by a steel spring to an insulated metallic disc 7 cm. in diam., which prevents lateral deviation. The cage is metallic and, by means of an adjustable disc connected to it and parallel to the insulated disc, the capacity of the apparatus may be given some definite value, *e.g.*, 10 cm. A circular scale is used with an alignment by which it can be read to ¼ division. The formula $\frac{1}{2}(c_\alpha - c_0)V^2 = pl\sin^2(\alpha/2)$—where c_α = capacity of system for angle of deflection α, C_0 = capacity for $\alpha = 0$,

V = p.d. between the insulated system and the cage, p = weight of leaf, l = length of leaf—giving the relation between V and a, is experimentally verified with regard to influence of weight, breadth, and length of leaf, and curves are drawn showing the variation of V with a for three different leaves. All three curves show that the sensibility decreases for deflections greater than 60°, the curves up to this point being almost rectilinear. The sensibility is, however, made very nearly constant over the whole range by altering the form of the cage to that of half a circular cylinder of which the axis coincides with that of the rotation of the leaf. This reduces to a minimum the change of capacity caused by deflection of the leaf, and the resulting curve, almost rectilinear throughout, varies but little from $V = K \sin (a/2)$, where K is a constant. An instrument has been constructed, embodying these improvements, which reads from 0 to 6,000 volts, and it can also be used in the measurement of quantities and capacities. G. E. A.

1684. *Resistivity of High-resistance Alloys at very High and very Low Temperatures.* **G. Niccolai.** (Accad. Lincei, Atti, 16. pp. 185–191, Aug. 4, 1907.)—The author has extended his researches [Abstracts Nos. 1567, 1568 (1907)] to the following high-resistance alloys: argentan, constantan, manganin, nickelin, 18-carat gold, rheotan. The specimens were in the form of wires 0·5 mm. in diam. and about 8 m. long, except in the case of gold (0·84 mm. diam., 8 m. long). The temperature range was the same as previously, + 400° to −189° C. The table above gives the resistivity in absolute electromagnetic units.

Temperature.	Argentan.	Constantan.	Manganin.	Nickelin.	18-carat gold.	Rheotan.
400°	31,610	44,810	38,258	38,640	14,376	48,200
375	31,541	44,810	38,340	38,635	13,625	48,200
350	31,445	44,810	38,416	38,600	12,940	48,185
325	31,332	44,810	38,486	38,552	12,819	48,178
300	31,184	44,810	38,553	38,470	11,777	48,090
275	31,005	44,810	38,612	38,332	11,819	47,945
250	30,798	44,800	38,665	38,171	10,944	47,738
225	30,578	44,790	38,704	37,988	10,617	47,480
200	30,341	44,778	38,742	37,787	10,684	47,195
175	30,097	44,757	38,776	37,581	10,089	46,890
150	29,857	44,725	38,808	37,393	9,860	46,575
125	29,630	44,672	38,832	37,295	9,647	46,298
100	29,393	44,621	38,847	37,000	9,452	45,910
75	29,160	44,518	38,852	36,802	9,247	45,595
50	28,925	44,405	38,855	36,605	9,018	45,278
25	28,688	44,277	38,832	36,407	8,779	44,960
0	28,457	44,138	38,787	36,200	8,531	44,645
− 25	28,281	43,974	38,723	36,008	8,274	44,327
− 50	27,995	43,808	38,640	35,798	8,017	44,000
− 75	27,767	43,632	38,542	35,600	7,760	43,682
− 100	27 538	43,428	38,427	35,402	7,493	43,373
− 125	27,303	43,205	38,304	35,207	7,238	43,040
− 150	27,071	42,975	38,165	35,008	6,967	42,704
− 175	26,840	42,732	38,019	34,797	6,700	42,366
− 189	26,718	42,604	37,937	34,692	6,546	42,198

The relation between resistivity and temperature is well shown in Fig. 1. The ratio of the resistivity at +400° to that at −189° is: for gold, 2·196; argentan, 1·188; rheotan, 1·142; nickelin, 1·114; constantan, 1·052; manganin, 1·008 [compare those for the pure metals, Abstract No. 1568 (1907)]. It is pointed out that structural modifications have a great influence on the resistivity. Annealing and hardening in particular affect not only the absolute value, but even alter the law of variation of resistance (*i.e.*, the form of the curve). Manganin, nickelin, and gold (18-ct.) were studied more particularly. Fig. 2 shows the resistivity curves in relation to temperature for two specimens (upper curves) of 18-carat gold in the original condition, and of one of these specimens (lower curve) after having been annealed several times. The greater the number of annealings the more the curve approaches the definite fixed shape of curve given in Fig. 1. L. H. W.

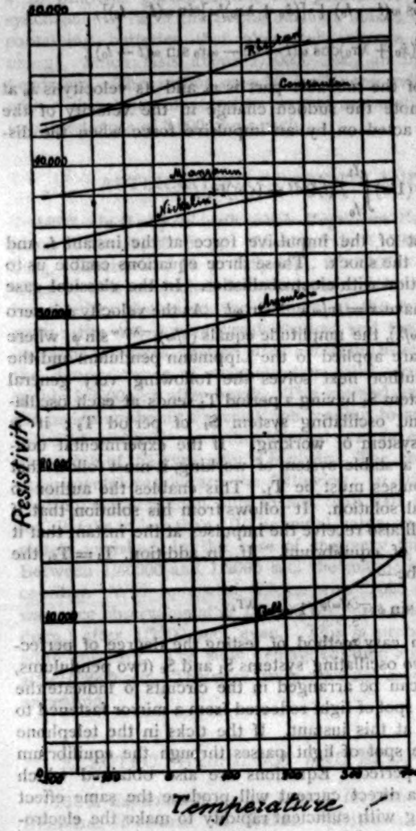

FIG. 1.

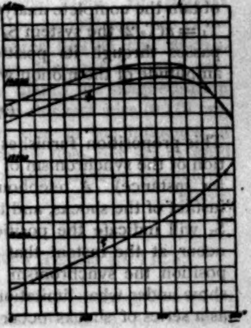

FIG. 2.

1685. *Theory of the "Electroballistic."* **A. Guillet.** (Journ. de Physique, 6. pp. 585–596, Aug., 1907.)—The moving part, consisting of coils or magnets, of a piece of apparatus supplied with transient currents the author calls an "electroballistic." A general theory which is applicable to all apparatus of this kind is developed, and solutions are obtained *without making any approximations.* The author discusses the general equation

$a\ddot{x} + b\dot{x} + cx = 0$. Writing $b/a = 2\lambda$ and $c/a = \omega^2 + \lambda^2$, he obtains the solution in the form—

$$x = \epsilon^{-\lambda(t-t_0)}[x_0 \cos \omega(t - t_0) + [(\dot{x}_0 + \lambda x_0)/\omega] \sin \omega(t - t_0)],$$

and—

$$\dot{x} + \lambda x = \epsilon^{-\lambda(t-t_0)}[(\dot{x}_0 + \lambda x_0) \cos \omega(t - t_0) - \omega x_0 \sin \omega(t - t_0)],$$

where the displacement x of the movable part is x_0, and its velocity is $\dot{x}_0$ at the instant $t = t_0$. If v denote the sudden change in the velocity of the electroballistic, when it is acted on by an impulsive force when the displacement is ξ we have—

$$v = (1/a)\int_{t_0}^{t_1} f(t, \xi)dt - (c/a)\xi\tau,$$

where $f(t, \xi)$ is the moment of the impulsive force at the instant t, and $\tau = t_1 - t_0 =$ the duration of the shock. These three equations enable us to solve all problems in connection with electroballistics. In the classical case when it starts from rest we have $x = (v/\omega)\epsilon^{-\lambda t} \sin \omega t$. As the velocity $\dot{x}$ is zero at the instant $t = (1/\omega) \tan^{-1}(\omega/\lambda)$, the amplitude equals $(v/\omega)\epsilon^{-\lambda\phi/\omega} \sin \phi$, where $\tan \phi = \omega/\lambda$. The equations are applied to the Lippmann pendulum and the Becquerel balance. The author next solves the following very general problem. An oscillating system S_1 having a period T_1 sends at each oscillation an impulse to a second oscillating system S_2 of period T_2; it is required to find the stable system of working. If the experimental conditions are compatible with a stable system of working, it must follow that the period between the impulses must be T_1. This enables the author to obtain the complete analytical solution. It follows from his solution that if $T_1 = k(T_2/2)$ the system S_2 will also receive the impulses at the instant that it passes through its position of equilibrium. If, in addition, $T_1 = T_2$, the amplitude of the motion will be—

$$(v/\omega) \sin \phi \epsilon^{-(\lambda/\omega)\phi}/(1 - \epsilon^{-\lambda T_2}).$$

This proposition furnishes an easy method of testing the degree of perfection of the synchronism of two oscillating systems S_1 and S_2 (two pendulums, for instance). A telephone can be arranged in the circuits to indicate the instant of the shocks, and the spot of light reflected from a mirror fastened to S_2 will indicate the position at this instant. If the ticks in the telephone occur at the instant that the spot of light passes through the equilibrium position the synchronism is perfect. Equations are also obtained which show under what limitations a direct current will produce the same effect as a series of shocks occurring with sufficient rapidity to make the electroballistic appear to be stationary. Lippmann's theorem also follows from the author's equations. It may be stated as follows. If two equal and opposite shocks take place when the moving part is in the same position on the outgoing and return swing, exact compensation ensues. The author has verified his conclusions by numerous experiments. In many researches in elasticity, electricity, and magnetism it would be most useful to employ an autoballistic repeater adapted for the particular phenomena under investigation. A. R.

1686. *Pendulum kept swinging electrically without making Contacts.* **H. Chrétien.** (Rev. Électrique, 8. p. 92, Aug. 15, 1907. Paper read before the Assoc. franç. pour l'avancement des Sciences at Rheims.)—A magnet fixed at the end of the pendulum oscillates in two solenoids and induces in them sine-shaped waves of e.m.f. The circuit of the solenoids is closed through a moving-coil galvanometer, the pointer of which consequently moves synchronously with the pendulum and makes contacts completing circuits containing batteries that alternately charge a condenser. During the charge, which lasts about 1/10000 sec., an impulsive force acts on the pendulum. The author uses 10 Leclanché cells, the liquid being covered with a thin layer of petrol to prevent evaporation, a 1-mfd. condenser and two resistances of 8,000 ohms each. A. R.

ALTERNATING CURRENTS AND MAGNETISM.

1687. *On the Speed with which Magnetism Vanishes.* **M. Gildemeister.** (Ann. d. Physik, 28. 8. pp. 401–414, July 5, 1907. Physiolog. Inst., Königsberg. Electrician, 59. p. 958, Sept. 27, 1907. Abstract.)—It is known that when iron is subjected to a magnetic field whose intensity is suddenly increased or decreased, the change in the magnetic state consists of two parts: the one a very rapid change, and the other a slow change which succeeds the rapid change after a certain interval. The author investigates the disappearance of magnetisation after removal of the magnetic field, within 1/2000 sec. after break. The method employed is that of Helmholtz, the pendulum being a special one reading to an interval between break and make of 1/600000 sec.; this interval was taken as the unit. A theoretical discussion of the experiments is given. The conclusions arrived at from the experimental results are the following: In 1/800000 sec. the rapidly-disappearing magnetisation falls to less than half its initial value. In 1/150000 sec. it falls to less than 1/10 its initial value, and after 1/50000 sec. has completely vanished, in the case of the very thin wires (0·0185 cm. diam.). Between 1/50000 and 1/2000 sec. the magnetisation does not decrease perceptibly. With somewhat thicker wire (0·028 cm. diam.) the magnetisation was once observable after 1/40000 sec., and with the thickest wire (0·118 cm. diam.) after 1/7500 sec. even. This is probably due to the influence of eddy currents. The slow demagnetisation apparently does not set in until after 1/2000 sec. The wire cores were not used for some days or weeks after annealing. L. H. W.

ELECTRO-PHYSIOLOGY AND ELECTRO-THERAPEUTICS.

1688. *Experiments on the Law of the Action of the Alternating Current on Organised Structures.* **E. Reiss.** (Zeitschr. Elektrochem. 18. pp. 474–477, July 26, 1907. From the Inst. f. physikal. Chemie d. Univ. Göttingen u. Berlin.)—In 1899 Nernst put forward the view that the current strength necessary to produce a definite physiological effect is proportional to the square root of the frequency of the applied alternating current, *i.e.*, $J = C\sqrt{N}$, where $C =$ constant. By means of special apparatus the author has tested the validity of this view on the sensory nerves of human beings. For frequencies of 80 to 8,500 per sec. the law is found to hold, but for frequencies lower than 80 the values of C increase as the frequency diminishes. The results are completely in accordance with the theoretical deductions of Nernst, and support the idea that in organised structures the electric current depends on alterations in the ionic concentrations, *i.e.*, on osmotic processes. T. S. P.

1689. *Radioscopy and Radiography employed in the Detection of Tuberculous Meat.* **H. Martel.** (Comptes Rendus, 144. pp. 1298–1300, June 10, 1907. Archives d'Él. Médicale, 15. p. 557, July 25, 1907. From the Semaine méd., June 19, 1907.)—Radioscopy affords a ready means of detecting tubercular lesions in the bronchial and mesenteric glands and in the lungs, while radiography is still more exact. A negative result cannot, however, be always relied upon. The method has many advantages over dissection, which takes much longer to perform and depreciates the value of the carcase.

H. W. P. Y.

1690. *Ophthalmological Experiments made with the aid of Light of Mercury Vapour.* **P. Fortin.** (Comptes Rendus, 145. pp. 355–358, July 29, 1907.)—The light from three Cooper Hewitt tubes is passed through two thicknesses of blue glass and received on the field of a large lens mounted in an opaque frame; the eye of the observer is placed close to the lens, a small screen with a pinhole aperture intervening. He then perceives an image of the fine structure of the fovea and the capillaries of the macula region, which has the appearance of a delicate histological preparation stained with methylene blue. The capillary network appears in very dark blue on a light blue ground, in the centre of which is the fovea, which looks like a deep blue stain composed of a multitude of small circles, corresponding probably to the visual cones. The retinal circulation can be examined in the same way by omitting the screen with the pinhole aperture, and in the capillaries are seen tiny black discs, which are the red cells. The phenomena known as Haidinger's tufts can also be observed by interposing two Nicol prisms.

H. W. P. Y.

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1691. *Force required to Stop a Moving Electrified Sphere.* **G. F. C. Searle.** (Roy. Soc., Proc. Ser. A. 79. pp. 550–563, Sept. 6, 1907.)—A mathematical consideration.

1692. *Relation between Luminosity and Electrical Conductivity of Flames.* **F. L. Tufts.** (Phys. Rev. 25. p. 70, July, 1907. Abstract of paper read before the Amer. Physical Soc.)—This paper replies to C. Fredenhagen, who called in question a conclusion of the author to the effect that the electrical conductivity imparted to the bunsen flame by the salts of sodium and lithium respectively varied directly as the luminosity of the yellow sodium line or the red lithium line. E. H. B.

1693. *Resistance of Bismuth and Nickel.* **F. C. Blake.** (Deutsch. Phys. Gesell., Verh. 9. 14. pp. 294–300, July 30, 1907.)—An account of an investigation of the influence of temperature and transverse magnetisation on the resistance of Bi and Ni, the results of which are in general agreement with those of previous observers. A large ring electromagnet was used giving a field up to 36,600 gauss, and fixed points of temperature were obtained by the employment of various substances with a definite melting or boiling-point between that of liquid air, − 192°, and + 184°, the boiling-point of aniline. J. J. S.

1694. *Control of Alternate-current Galvanometer.* **A. H. Taylor.** (Phys. Rev. 25. pp. 61–63, July, 1907.)—This paper discusses the theory of the control of a d'Arsonval galvanometer having a laminated iron field separately excited by a current drawn from the same source as the alternating current to be detected. [See also Abstracts Nos. 611 (1904) and 1913 (1906).] E. H. B.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1695. *α-Particles and the Periodic System.* **A. van den Broek.** (Ann. d. Physik, 23. 1. pp. 199–208, May 28, 1907.)—Rutherford has shown that the electrochemical equivalent of the α-particle *e/m* is one-half that of hydrogen in electrolysis, which implies that the α-particle is (1) H_2 with unit charge, or (2) He with a double charge, or (3) $\frac{1}{2}$He with a single unit charge. The author adopts the third view, and describes the "atom" which constitutes the α-particle as an *alphad*. This he regards as the fundamental atom from which all the others (except hydrogen ?) are built up. In justification of this view he exhibits a periodic arrangement of the elements in 15 rows of 8 members, including all the even members from 2 to 240. The elements fit very nicely into the system, although the actual atomic weights differ in some cases by 3 or 4 units from the theoretical (integral) values. It is, however, noteworthy that whilst the sum of the theoretical values in the table is 7728, the sum of the actual values is 7728·65—a difference of only 0·06 per cent. The same fact is also illustrated by plotting the theoretical and actual values against one another; the result is a sinuous line which fluctuates irregularly above and below the 45° diagonal. T. M. L.

1696. *Chemical Actions of Radium Rays.* **W. P. Jorissen** and **W. E. Ringer.** (Archives Néerlandaises, 12. pp. 157–174, 1907.)—Radium causes a diminution in the volume of a mixture of equal volumes of hydrogen and chlorine, but no action is observable on detonating gas even after 71 hours. The action of radium also decomposes iodoform dissolved in chloroform; with 5 mgm. of radium bromide acting on 50 c.cm. of a 1 per cent. solution of iodoform in chloroform at 25°, equilibrium is reached when 75·2 per cent. of the total iodine is liberated, whilst in a similar solution not exposed to the action of radium only 18·8 per cent. of the iodine is set free. T. H. P.

1697. *Atomic Weight of Cobalt.* **F. H. Parker** and **F. P. Sexton.** (Nature, 76. p. 316, Aug. 1, 1907.)—It has recently been suggested by J. J. Thomson that the accepted atomic weight of cobalt, namely, 59·0, is probably too high, and that the true atomic weight of Co is less than that of Ni. This suggestion was founded on the results observed with secondary radiation. The authors have made an attempt to determine the atomic weight electrolytically by direct comparison with silver, and obtain as the mean of fifteen determinations a value of 57·7 for the atomic weight. They have also attempted to compare the atomic weights of Co and Ni directly with each other and with that of silver by passing the same current through three voltameters in series, but on account of unexpected difficulties due to secondary reactions in the case of Ni, have not yet obtained satisfactory results. The investigation is being continued. The absorption of Co and Ni for the β-radiation from uranium also indicates a smaller atomic weight for Co than for Ni. A. W.

1698. *Chemical Action of Kathode Rays.* **J. Štěrba.** (Akad. Wiss. Wien, Sitz. Ber. 116. 2b. pp. 295–307, March, 1907. Monatsh. f. Chemie, 28.

pp. 397–409, 1907.)—In view (1) of the different explanations which have been advanced of the behaviour of alkali salts under the action of kathode rays [see Elster and Geitel, Abstract No. 1173 (1898); Siedentopf, Abstract No. 75 (1906)], and (2) of the great modification of such behaviour by the presence of small traces of impurities, the author prepares sodium chloride, nitrate and sulphate, and potassium chloride and chlorate in a highly purified state, and exposes them to the action of kathode rays. When thus treated, sodium chloride shows a white fluorescence which changes to blue, the salt becoming brown and finally blackish blue. The particles of salt are attracted by the kathode, the kathode-light becoming orange and the vacuum diminishing rapidly. The residue is found to be alkaline, the formation of free chlorine is confirmed, and it is considered that the blackish-blue residue contains metallic sodium. The other salts exhibit similar behaviour when acted on by kathode rays; the nitrate gives a residue containing nitrite, whilst the chlorate residue contains hypochlorite and chloride, as well as free alkali metal. It is therefore concluded that the action of the kathode rays leads to the decomposition of alkali salts into their components either directly or by stages. T. H. P.

1699. *Volume and Valency, Atom and Electron.* **J. Traube.** (Ann. d. Physik, 22. 3. pp. 519–542, March 5, 1907. Techn. Hochschule, Charlottenburg.)—(I.) A table is given of the molecular refractions M_α of 68 organic compounds, together with the sum *n* of the valencies of the elements in each compound. It is shown that the ratio M_α/n is substantially constant at 0·787 ± 1 per cent. In only about one-third of the cases quoted does the error exceed 1 per cent., and in half of these the error is less than 2 per cent. The law thus revealed may be enunciated as follows: *In organic compounds containing the elements H, O, N, C, F, Cl* (and in part *P, B, Si*) *the atomic refractions are in simple multiple proportions* corresponding with the valencies 1, 2, 3, 4, 5, 7. In illustration of this law a table is given showing that *compounds containing the same total valencies have equal molecular volumes.* [It is noteworthy that the author makes chlorine heptavalent, and thus equivalent to cyanogen, CN = 4 + 3, whilst Barlow and Pope, working on crystal volumes, make chlorine monovalent.] The author has already advocated the view that the atomic refraction of an element is a measure of the volume actually occupied by the atom, as contrasted with the sphere of influence typified by the constant *b* of van der Waals' equation; this conception, taken in conjunction with the law enunciated above, implies that *the actual volume of an atom is proportional to its valency.* In the case of elements and compounds containing double or triple bonds the ratio M_α/n is found to be less than 0·787, or, conversely, the calculated sum of the valencies $M_\alpha/0{\cdot}787$ is greater than the actual value *n*. Even more extreme exceptions are found in the case of compounds containing the elements Br, I, S, Se, or metals; after allowing normal valencies for C, H, &c., the ratio $M_\alpha/0{\cdot}787$ gives for the valencies of Br, I, &c., values ranging from 11 up to 17. These appear to be attributed by the author to residual affinity, but reduce considerably the value of his theory. (II.) A rough proportionality exists between the actual volumes of the atoms as determined from the molecular refraction M_α, and the volume *b* of the molecular sphere of influence. The latter should therefore also be proportional to the sum of the valencies, but this relationship is less exact, whether the comparison is made at 0° abs, at the critical temperature, at the boiling-point, or at 0° C. [Compare Abstract No. 904 (1907).] T. M. L.

1700. *Scale of Molecular Weights of Gases.* **D. Berthelot.** (Comptes Rendus, 145. pp. 180–183, July 16, 1907.)—The author discusses the determination of the molecular weights of gases from their densities [see Abstract No. 724 (1907)]. Guye [Abstract No. 1548 (1907) and previous papers] assumes that the molecular weight of a gas can be calculated, knowing its compressibility and density alone, by means of the formula, $M = V_0 d(1 - A)$. But this is an illusion, since V_0 has not an *a priori* value, but is defined by the expression: $V_0 = M/d(1 - A) = M'/d'(1 - A') =$ &c., its actual value being obtained by substituting in this expression the observed magnitudes of the various terms for a particular gas, generally oxygen. Guye has also adopted for V_0 the value 22·412, obtained from the molecular weights of a number of gases, and has employed this value of V_0 to calculate the molecular weights of the same gases. T. H. P.

1701. *Green and Blue Gold.* **L. Houllevigue.** (Journ. de Physique, 6. pp. 596–608, Aug., 1907. Paper read before the Soc. franç. de Physique, July 5, 1907.)—When minute pellicles of gold are deposited on glass by ionoplastie or kathodic projection, two kinds of gold are obtained, one, green by transmitted light and optically identical with gold-leaf, the other blue by transmitted light and pale yellow by reflection. Deposits may be formed which are intermediate between these two types. Betz [Abstract No. 287 (1906)] considers the blue gold to have the composition Au_2O_3, but when used as anode in the electrolysis of water it turns into the green variety by the action of the oxygen set free. It is therefore considered to be a hydride of gold. Further, if the blue gold is examined by spectrum analysis in a vacuum tube, the tube gives hydrogen lines after the gold has been heated. The method of carrying out this second experiment is fully described. The change of blue into green gold with heat was investigated by observing the change of its electrical resistance with rise of temperature; this takes place between 120° C. and 290° C., the resistance gradually decreasing as the temperature rises from 120° to 290°; the change is a permanent one [see also Abstract No. 1684 (1907)] Other experiments are described to show that gold kathodes contain hydrogen, and that gold deposited by ionoplastie is the blue variety. G. E. A.

1702. *Preparation of Zirconium Carbide.* **E. Wedekind.** (Chem. Zeit. 31. pp. 654–655, 1907.)—Natural zirconia in the finely-powdered state mixed with pure charcoal yields, when heated in an electric furnace for some time, with 600 amps., zirconium carbide containing about 1 per cent. of impurity. In the compact state the metallic mass has a high electrical conductivity. L. H. W.

1703. *High Temperatures for Crucibles.* **C. Chabrié.** (Comptes Rendus, 145. pp. 188–189, July 16, 1907.)—The author has burned various mixtures of aluminium and magnesium, with oxygen or with metallic oxides, in order to heat the inner of two concentric crucibles. The best results are obtained with Goldschmidt's aluminium thermit. The inner crucible consists of magnesia, and the annular space between the two crucibles is packed with thermit. Instead of the inner crucible he also applies a tube of magnesia, passed through holes made in the outer crucibles; porcelain tubes would melt. H. B.

1704. *Constitution of Ammonium Amalgam.* **G. McP. Smith.** (Amer. Chem. Soc., Journ. 29. pp. 844–855, June, 1907. Contribution from the Chem. Lab., Univ. of Illinois.)—From a full investigation of the subject, the author concludes that the theory of Le Blanc, according to which ammonium amalgam is a compound of the metallic radical NH_4 with Hg, is the correct one, and dismisses as untenable the views of Moissan that the substance is a simple or double ammoniacal hydride of mercury, and of Rich and Travers that it is a solution of free NH_4 in Hg. This is based on the facts that (1) an extension of Moissan's experiments with sodium amalgam and ammonia to amalgams of K, Li, Ba, Sr, and Ca, shows that these all become inflated when treated with aqueous ammonia; (2) ammonium amalgam displaces Ba and K from solutions of their salts, proving that the radical NH_4 in ammonium amalgam has the property of an alkali metal; and (3) cryoscopic measurements of the depression of the freezing-point indicate that ammonium amalgam is a solution in mercury of a substance of the empirical form $NH_4 . Hg_n$. W. H. Si.

1705. *Action of Ozone on Metallic Silver and Mercury.* **W. Manchot** and **W. Kampschule.** (Ber. Deut. Chem. Gesell. 40. pp. 2891–2898, 1907. Chem. News, 96. p. 59, Aug. 2, 1907. Abstract.)—The action of ozone on Ag and Hg has been observed at various temperatures. With pure Ag a milk-white deposit is produced at 100° C.; at 154° a dark-blue or steel-blue film appears, and between 220° and 240° the action is most marked becoming feebler above the latter temperature, until at 450° no change is perceptible. The result is the same whether damp or dry ozone is used. The blackening of Ag in the cold even by very dilute ozone is found to be due to the presence on its surface of very minute quantities of some catalyst such as oxide of silver, cobalt, or nickel. Heating to redness does not remove all trace of oxide from the surface. Mercury is acted upon in a similar manner, the effect of the ozone first increasing, then decreasing, and finally disappearing; but the temperature intervals in which the changes take place are somewhat lower.

W. H. Si.

1706. *Annealing of Sterling Silver.* **W. H. Walker.** (Amer. Chem. Soc., Journ. 29. pp. 1198–1201, Aug., 1907. Contribution from the Research Lab. of Technical Chemistry, Massachusetts Inst. of Technology, No. 1.)—Points out that "sterling" silver (7·5 per cent. Cu and 92·5 per cent. Ag) suffers in its physical properties under mechanical treatment, becoming hard, stiff, and brittle. Annealing by heating to low redness eliminates these undesirable features, but produces on the alloy a scale of black copper oxide which diminishes the lustre and market value of the goods. This undesirable appearance is found to penetrate the silver alloy to a distance roughly proportional to the number of times that annealing has been resorted to. Immersion in strong nitric acid is necessary to dissolve away the alloy until the darkened portion has disappeared. The author attributes the appearance of this black surface layer to the formation of copper oxide during annealing, and therefore urges that this process should be carried on in an atmosphere containing little or no oxygen. An attempt to use illuminating gas was unsuccessful, as, although the oxide was eliminated, minute blisters were produced; these are ascribed to the penetration of the silver by hydrogen or hydrocarbon gases, which reduce the copper oxide to metallic copper with formation of water. Experiments showed that hydrogen, methane and acetylene were very active in producing blisters, while nitrogen and carbon dioxide were entirely inert, carbon monoxide occupying an intermediate position. The most desirable atmosphere from a chemical point of view is one containing enough reducing gases to prevent the penetration of the small amount of oxygen present, and enough inert gas to prevent the penetration of the reducing gases. Practically this is best obtained from a producer delivering a gas containing approximately two-thirds CO_2 and nitrogen, and one-third CO with a small amount of hydrogen. W. P. D.

1707. *Platinum Silicide and a Double Silicide of Platinum and Copper.* **E. Vigouroux.** (Comptes Rendus, 145. pp. 876–878, Aug. 5, 1907.)—The author claims priority over Lebeau and Novitzky [see Abstract No. 1598 (1907)] in the description of the compound SiPt (Soc. des Sciences, Bordeaux, July 11, 1907). It is formed directly when Si is in excess. If Al be present it tends to dissociate the compound; Cu tends to displace the Pt, combining with the Si. $SiCu_4$ readily combines with SiPt or with Pt, forming a double silicide. F. R.

1708. *Iron-Platinum Alloys.* **E. Isaac** and **G. Tammann.** (Zeitschr. Anorg. Chem. 55. 1. pp. 63–71, Aug. 7, 1907. Metallographic Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—The authors give a partially complete temperature concentration diagram for the Fe-Pt alloys. These metals form, from the molten condition, an uninterrupted series of mixed crystals. At about 20 per cent. Pt, there is a minimum [1,500°]. At lower temperatures transformations occur, and there are two series of mixed crystals at ordinary temperatures, viz., from about 0 to 50 and 60 to 100 per cent. Pt respectively. The curves of transformation fall from the Fe change-points to about 0° with 52 per cent. Pt, and from 400° with 84 per cent. Pt, to 200° with 60 per cent. Pt. Another curve is indicated, from 1,400° with 94 per cent. Pt, to 1,100° with 70 per cent. Pt. Upon heating alloys containing from 0 to 50 per cent. Pt they lose their magnetic property at temperatures ranging from 800° to 640°; this is recovered practically upon passing the curve of thermal critical points mentioned above. There is thus considerable irreversibility. F. R.

1709. *Alloys of Copper and Iron.* **H. Wedding** and **W. Müller.** (Stahl u. Eisen, 26. pp. 1444–1447, 1906.)—The aluminothermic method is convenient for the production of these alloys. Copper alloys with iron in all proportions; Cu reduces the malleability of the Fe, but the strength and hardness are augmented. Metallographic examination of an alloy containing, in per cent., Cu 7·77, C 0·14 did not reveal any separate constituent, but it was noticed that the crystal grains are more curved and interlocked than in pure Fe. Cu appears to hinder the formation of pearlite in higher-carbon alloys, and segregated cementite appears. Addition of Cu lowers the transformation-temperature to 620–640° C. L. H. W.

1710. *Nickel-Tin Alloys.* **E. Vigouroux.** (Comptes Rendus, 145. pp. 246–248, July 22, and pp. 429–431, Aug. 19, 1907.)—The alloys containing from 40 to 57·65 per cent. [see *erratum* on p. 580] as well as those from 57·65 to 66·76 per cent. Sn tend, upon treatment with hydrochloric acid, to leave a residue of composition corresponding to Ni_3Sn_2; upon treatment with nitric acid the residue is approximately of composition corresponding to NiSn. The brittleness of the alloys containing from 0 to 40 per cent. Sn increases with Sn; above 66·76 per cent. Sn (corresponding to NiSn) brittleness diminishes. From 85 to 100 per cent. Sn they are to a certain extent malleable. They are markedly sonorous between 66·76 and 85 per cent. Sn. [See also Abstract No. 1420 (1907).] F. R.

1711. *Aluminium-Copper Alloys.* **H. C. H. Carpenter** and **C. A. Edwards.** (Inst. Mech. Engin., Proc. 1. pp. 57–269; Discussion, pp. 270–378, Jan.–March, 1907. Abstracts in Engineering, 83. pp. 127–129, Jan. 25; 158–162, Feb. 1; 253–254; Discussion, pp. 233–236, Feb. 22, and pp. 299–304, and 306–307, March 8, 1907. Mech. Eng. 19. pp. 155–159, Feb. 2, 1907. Bull. Soc. d'Encouragement, 109. pp. 178–185, Feb., 1907.)—The equilibrium curves so far as they have been studied by the authors confirm generally Guillet's results [see Abstract No. 2124 (1905)]. It was found, however, that the liquidus in the neighbourhood of 44·5 to 50 per cent. Al does not rise, but is nearly a horizontal straight line. From 0 to 13 per cent. Al the solidification is in each case completed at the temperature at which it commences. Evolutions of heat occur in the 8 to 13 per cent. Al alloys at temperatures between 500° and 600° C. For small castings there is no need to re-melt in order to get sound metal; the lowest pouring temperature consistent with fluidity is the best. The total linear contraction of castings cooling from the solidification-point to ordinary temperature was from 1·83 to 2·34 per cent. for the copper-rich alloys, and uniformly 1·66 per cent. for alloys from 0 to 3·76 per cent. Cu. A chill casting and a rolled bar of the same composition have the same sp. gr. The sp. gr. of Cu is reduced according to a smooth curve upon addition of Al up to 13 per cent. The results of mechanical tests show that the limits for practically useful alloys are 0 to 11 per cent. Al and 0 to 4 per cent. Cu. From 0 to over 7 per cent. Al, the alloys have low yield-points, moderate tensile strength, high elongation, almost uniform hardness (Brinell), extremely high deformation before rupture in torsion, and good resistance in dynamic tests. This series is not very sensitive to heat treatments, and is much improved by mechanical work. From 8 to 11 per cent. Al the yield-point is low, maximum stress good, ductility good (up to 10 per cent.), hardness rapidly increases, resistance to torsion and impact falls. A parallel in many respects can be drawn between the properties of an alloy with 9·9 per cent. Al (the well-known "aluminium-bronze" or "aluminium-gold"), and a carbon steel of about 0·35 per cent. C. It is shown that the yield-point of the copper-rich alloys is the same as that corresponding to the limiting stress to produce failure under a million reversals; this is different from the case of steel, whose yield-point as observed in static tests is higher than the real value, probably through the mechanical treatment which it undergoes. In order best to develop the properties of the Al-rich alloys, it is essential to submit them to considerable mechanical working. With 3·76 per cent. Cu the following figures were obtained: sp. gr. 2·79; yield-point, 18·5 tons per sq. in.; ultimate stress, 20 tons per sq. in. The Cu-rich alloys are practically incorrodible by sea-water, whether alone or in contact with steel. They are in this respect superior to Muntz metal and naval brass. In tap-water the positions are reversed. The Al-rich alloys are readily corroded by sea-water but not by tap-water. In the *discussion*, **F. Tomlinson** gave figures in support of his view that the yield-points obtained by the authors for the alloys were generally unduly high. He had found a great rise of temperature on addition of Al to Cu. (The **Authors**, however, held the opinion that this was due to oxidation of Al by oxygen present in the Cu.) **W. Rosenhain** gave results showing that in the case of 9·9 and 6·78 per cent. Al alloys the tenacity decreased with increasing temperature; the fall was rapid in each case above 350° C. The elongation of the 6·78 per cent. alloy fell rapidly with increasing temperature. F. R.

1712. *Alloys of Sb with Mn, Cr, Si, and Sn; of Bi with Cr and Si; and of Mn with Sn and Pb.* **R. S. Williams.** (Zeitschr. Anorg. Chem. 55. 1. pp. 1–33, Aug. 7, 1907. Metallographic Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Gives temperature-concentration diagrams and microstructure of this series of binary alloys, with remarks on their magnetic properties. Sb-Mn: compounds, Sb_2Mn_3 solidifying at 852°, and $SbMn_2$ at 919°; solid solutions from 50 to 60 and from 65 to 69 atoms per cent. Mn. $SbMn_2$ is the most magnetic alloy of the series. Sb-Cr: compounds, Sb_2Cr solidifying at 675°, and SbCr at 1,115°; solid solutions from 50 to 52·5 and from 95 to 100 atoms per cent. Cr. Sb-Si: no compounds; solid solutions from 0 to 0·3 and from 99 to 100 per cent. by weight Si. Sb-Sn: compound, SbSn (?); solid solutions from 0 to 8, 50 to 58 and 90 to 100 atoms per cent. Sb. Bi-Cr: no compounds, no solid solutions; the metals are immiscible in the molten state. Bi-Si: no compounds; solid solutions from 0 to 0·8 per cent. by weight Si; from 2 to 100 per cent. Si, immiscibility in the molten condition. Mn-Sn: compounds, $SnMn_4$, $SnMn_2$, SnMn (?); temperatures of solidifying, 989°, 898°, 541° respectively; solid solutions from 96 to 100 atoms per cent. Mn. The magnetic properties of the Mn-Sn alloys are more marked than the others of these series. From 67 per cent. Mn the magnetic permeability rapidly increases with increasing Mn to a maximum corresponding to $SnMn_4$, decreasing again to vanishing at 95 per cent. Mn. In this same range the alloys are also capable of permanently retaining magnetism. These properties disappear in $SnMn_4$ at about 115° to 119°. Mn-Pb: no compounds, no solid solutions, immiscibility in molten state from 12 to 90 per cent. by weight Mn; the alloys are non-magnetic. F. R.

1713. *Equilibrium Diagrams of the Systems: Lead Sulphide-Iron Sulphide, and Lead Sulphide-Silver Sulphide.* **K. Friedrich.** (Metallurgie, 4. pp. 479–485, July 22, 1907. Communication from the Metallograph. u. Metallurg. Laborat. d. Kgl. Bergakademie, Freiberg.)—The determinations were made with lead sulphide containing 87·1 per cent. Pb, magnetic pyrites with 62·35 per cent. Fe, and silver sulphide with 99·6 per cent. of Ag_2S; the solidifying-points of these were 1,114°, 1,187°, and 835° C. respectively. Lead sulphide and magnetic pyrites form a eutectic containing about 70 per cent. lead sulphide and solidifying at 863°. With the exception of a line at 175°, probably corresponding to the transformation of Ag_2S, the diagram for the lead and silver sulphides is of similar form to the foregoing, the eutectic point being at about 630° C., with 77 per cent. of Ag_2S. Neither system shows a maximum. The paper is illustrated by micrographs. F. R.

1714. *The Binary Systems: Iron with Lead, Bismuth, Thallium, and Cadmium.* **E. Isaac and G. Tammann.** (Zeitschr. Anorg. Chem. 55. 1. pp. 58–62, Aug. 7, 1907. Metallographic Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Fe does not dissolve in nor form compounds with either Pb or Bi. Solid Fe does not dissolve in Tl; as Fe melts above the boiling-point of Tl, experiments at the ordinary pressure do not decide whether there is solution in the molten state or not. Cd is insoluble in Fe. The authors were, however, unable to decide whether when Fe is kept for some time in molten Cd, the Fe is insoluble, or an insoluble compound of Fe and Cd is formed. F. R.

1715. *Methods of avoiding Piping in Steel Ingots.* **A. Obholzer.** (Frank. Inst., Journ. 164. pp. 1–11, July, 1907. Extract from Report.)—Refers to practice in the Hungarian Government steel foundries at Diosgyör. The use of Anti-piping Thermit is stated to be very satisfactory, especially in connection with a sinking head, and protection of the head from cooling by means of sand and charcoal on the surface. The use of charcoal, however, is apt to increase the amount of segregated carbon. Photographs of sections of ingots are given in support of the views, and also analyses at various points of the ingots. The formula $h = H/2{\cdot}4$ is said to be practicable, h being the height of feeding head, and H the height of the useful pipeless portion of the ingot. F. R.

1716. *Heat of Combustion of Silicon and Silicon Carbide.* **W. G. Mixter.** (Amer. Journ. Sci. 24. pp. 130–140, Aug., 1907. Communication from the Sheffield Chem. Lab., Yale Univ.)—The heat of combination of Si (crystalline) with C (amorphous) is given as 2,000 cals.—a result so small that it can only be said to indicate that the formation of SiC is accompanied with very small evolution or absorption of heat. The other heats of combination arrived at are:—

$SiC, 2O_2$	288,800 cals.
Si (crystalline), O_2	191,000 „
$2Na_2O, SiO_2$ (amorphous)	84,000 „

In the latter case the directly observed figure was 71,000, but the given result was preferred, the difference being due either to an error of 5 per cent. in heat of oxidation of Si, or to the formation of a mixture of silicates in the experiments with silica. F. R.

1717. *Behaviour of the Halogens (especially of the Systems Chlorine-Bromine and Chlorine-Iodine) to one another.* **B. J. Karsten.** (Zeitschr. Anorg. Chem. 53. 4. pp. 365–392, May 4, 1907. Universitätslaborat., Amsterdam.)—The complete melting- and boiling-point curves were determined for the system Cl-Br; they show that chlorine and bromine do not enter into chemical combination either in the gaseous, liquid, or solid states; from the melting-point curve it is clear that a continuous series of mixed crystals may be formed. The boiling-point curve of the system chlorine-iodine was traced out; it shows that the compound ICl is only slightly dissociated even at 100°. The author gives a general review of the mutual affinities of the halogens. The most stable chemical union is between iodine and fluorine—the elements most widely separated by their atomic weights. D. H. J.

1718. *Relations between the Molecular Conductivity of Electrolytes and the Dilution.* **M. Prud'homme.** (Bull. Soc. Chim. 1. pp. 562–569, 1907. Zeitschr. Elektrochem. 13. pp. 471–474, July 26, 1907. Extract and Translation.)—According to the author the connection between the molecular conductivity and dilution of an electrolyte is given by the expression $\log\left(\frac{1}{1-\lambda}\right) = av^{\frac{1}{n}}$, where a and n are constants, v is the dilution in litres, and λ is the ratio of the molecular conductivities at the dilutions v and

10,000 litres. The value of a (the volumetric coefficient) is practically the same for salts of one and the same acid, if the metals possess the same valency; it becomes greater, the smaller the value of $1/n$ (the volumetric exponent) is, and its extreme values stand in the ratio of approximately 6 : 1 for good electrolytes. The value of n varies between $n = 6$ for binary strong electrolytes with monovalent ions and $n = 2$ for weak electrolytes. For electrolytes with two divalent ions $n = 8$. The volumetric coefficients of the acids HCl and HNO_3 are approximately the same ($a = 0{\cdot}780$), being greater than those of the corresponding salts of monovalent metals. The volumetric coefficient of $\frac{1}{2}H_2SO_4$ lies between those of the sulphates of the mono- and di-valent metals. The value of n is practically identical for HCl and HNO_3 ($n = 5{\cdot}7$ and $5{\cdot}5$ resp.), and also for the chlorides and nitrates of the monovalent metals. The value of n for H_2SO_4 is approximately the same as that for the sulphates of the divalent metals ($n = 8{\cdot}2$). The equation given above is also true when λ is substituted by γ, the degree of dissociation, and the author further deduces the general expression $\frac{\gamma^m}{(1-\gamma)^{m-1}} v^{-\frac{1}{p}} = \text{const.}$, where p and m are constants, which must satisfy the equation—

$$m/81 + (m - 1)/22 = 1/p.$$

Rudolphi's and van't Hoff's equations are particular cases of this general equation. T. S. P.

1719. *Stratifications occurring during Diffusion.* **R. E. Liesegang.** (Zeitschr. Phys. Chem. 59. pp. 444–447, June 11, 1907.)—The formation of concentric rings of silver dichromate when a drop of silver nitrate solution is placed on the surface of solidified gelatine containing potassium dichromate has been attributed by Ostwald and others to supersaturation of the solution with respect to the silver dichromate. The author finds, however, that when a drop of potassium dichromate solution is placed on such rings, the dichromate diffuses into the gelatine and interacts with the excess of silver nitrate remaining to form fresh concentric rings independent of and often crossing the others. This observation can scarcely be explained by the supersaturation hypothesis. T. H. P.

1720. *Thermo-endosmosis between two Liquids or Gases.* **G. Lippmann.** (Comptes Rendus, 145. pp. 104–105, July 8, 1907.)—It has been found that if two layers of pure water, one hot and the other cold, are separated by a membrane, a process of endosmosis takes place from the cold to the hot water, exactly comparable to that between water and sugar solution. (Ibid. pp. 105–106, July 8, 1907.)—The same phenomenon is shown in a very marked way when hot and cold air are separated by a paper membrane. T. M. L.

1721. *Spontaneous Crystallisation of Binary Mixtures. Experiments on Salol and Betol.* **H. A. Miers** and **Miss F. Isaac.** (Roy. Soc., Proc. Ser. A. 79. pp. 322–351, July 10, 1907.)—The authors have already noted the existence of a supersaturation limit above which the solution or liquid mixture is "metastable" and will only crystallise in contact with a solid crystal, whilst below it the liquid is "labile" and may crystallise spontaneously. Solutions in open vessels may crystallise "spontaneously" from a few centres when metastable, owing to inoculation by crystalline dust; solutions in sealed tubes, even when vigorously shaken, can only crystallise when cooled below the temperature at which they become labile. The previous experiments were carried out with aqueous solutions in which only the salt could crystallise at the temperatures of experiment; in the present series salol (phenyl salicylate, m.p. 42½° C.) and betol (β-naphthol salicylate, m.p. 92° C.) were used in order that the crystallisation of both substances might be observed. The former crystallises spontaneously at 33° and the latter at 79° when vigorously shaken, giving rise in each case to a dense "labile" shower of crystals, quite different from the thin "metastable" shower which separates when crystallisation takes place at higher temperatures. These two points form the ends of two supersaturation curves, which correspond with the ordinary saturation or freezing-point curves, but at lower temperatures, in the present instance about 10–25° C. lower. The two supersaturation curves intersect in a "*hypertectic*" point (15° C.), below which spontaneous crystallisation of both constituents may take place; this point corresponds with the eutectic point at which the ordinary saturation curves intersect. In most experiments on alloys and other mixtures agitation and inoculation have been freely employed, so that nuclei have been developed round which the different constituents could crystallise. In the actual solidification of metals on a large scale, however, and in the solidification of natural rocks, these conditions are not present and supersaturation must frequently occur. Crystallisation is then determined by the position of the supersaturation even more than by the saturation curves. As one illustration of this, eutectic mixtures are scarcely ever found in rocks, probably because one constituent usually reaches the supersaturation limit considerably earlier than the other; the liquid which would be most likely under these conditions to yield a fine-grained solid is not that which has the eutectic, but that which has the hypertectic, composition. Other illustrations of the importance of the supersaturation curves are given by reference to the work of Heycock and Neville, and of Roberts-Austen on alloys; the former appear to have noted in at least one instance the appearance of what the authors describe as metastable and labile showers, in the crystallisation of the copper-tin alloys. T. M. L.

1722. *Limit between the Solid and Liquid States in Gelatine.* **C. Rohloff** and **Shinjo.** (Phys. Zeitschr. 8. pp. 442–446, July 1, 1907.)—Elasticity measurements were made of gelatine jellies of different concentrations and at different intervals after preparing the solutions. The apparatus used consisted of an outer sphere of nickeled copper and an inner sphere supported concentrically by a bifilar suspension, the jelly being formed in the intermediate space. Curves are given showing the gradual increase of elasticity from day to day in solutions of different concentrations; in each case, however, it was found that an interval elapsed before any elasticity could be detected, varying from 0·48 day in the case of a 0·425 per cent. solution to 3·80 days in the case of a 0·20 per cent. solution. A second series of curves is given showing the relationship between elasticity and concentration, 1, 2, 3, 5, 10, and 18 days after preparing the solutions. T. M. L.

1723. *Heat of Dilution of Concentrated Solutions.* **G. Rümelin.** (Zeitschr. Phys. Chem. 58. pp. 449–466, March 15, 1907. Extract from Inaugural-Dissertation, Göttingen.)—An electrical method of calibrating the Steinwehr double-calorimeter is described, and a modification is recorded by which heat-changes of a few gm.-cal. can be measured within 1 per cent. The heat liberated in the formation of 1 gm.-molecule of water was found to be 68,150 cals. at constant pressure. The heat of dilution was determined for solutions of sulphuric acid, phosphoric acid, sodium nitrate, and calcium nitrate. T. M. L.

1724. *Structure of Asymmetric Sodium Chlorate Crystals.* **H. Copaux.** (Comptes Rendus, 144. pp. 508–510, March 4, 1907.)—In addition to the ordinary cubic form of sodium chlorate, which is characterised by the property of rotating the plane of polarisation of light, there are a labile α orthorhombic form isomorphous with potassium nitrate, a labile β "clinorhombic" form isomorphous with potassium chlorate, and a γ form, orthorhombic and quasi-cubic. The two former are produced by evaporation of an alcoholic solution, the third is produced by crystallising in presence of sulphate or perchlorate; the two former are much more soluble than the cubic form, but the latter is stable and actually crystallises in aggregates similar to Reusch's mica spirals in such a way as to produce an optical rotation; it is therefore probable that the cubic crystals are made up of particles of the γ form arranged in this way to form a cubic aggregate.
T. M. L.

1725. *Vapour Pressure of Iodine.* **G. P. Baxter, C. H. Hickey,** and **W. C. Holmes.** (Amer. Chem. Soc., Journ. 29. pp. 127–136, Feb., 1907. Contribution from the Chem. Lab. of Harvard Univ.)—The vapour pressure of solid iodine was determined by titrating the iodine vapourised by a known volume of air passed over iodine heated or cooled to a constant temperature. The values obtained were—

T. =	0	15	25	30	35	40	45	50	55° C.
V.P. =	0·030	0·131	0·305	0·469	0·699	1·025	1·498	2·154	3·084 mm.

The molecular heat of sublimation calculated from the temperature coefficient of vapour pressure was 15,100 gm.-cals. or 63,000 joules. T. M. L.

1726. *Absorption of Nitric Oxide by Solutions of Ferrous, Nickelous, Cobaltous, and Manganous Salts.* **G. Hüfner.** (Zeitschr. Phys. Chem. 59. pp. 416–423, June 11, 1907.)—Manchot and Zechentmayer have shown that the absorption of NO by ferrous salts is due to the formation of a trivalent form of iron and is limited to one molecular proportion, *e.g.*, $Fe''Cl_2 + NO = Fe'''(NO)Cl_2$. The author finds that the volume of gas absorbed can be expressed by the equation $v = a + bp$, but that the constant a is relatively so small that the absorption proceeds within the somewhat narrow limits of his experiments substantially according to Henry's law. The following table exhibits the curious character of the results obtained on varying the iron concentration—

Iron in 205·7 c.cm.	NO equivalent to Iron.	NO absorbed by Pure Water.	NO actually Absorbed.
0·0221 g.	8·82 c.cm.	9·68 c.cm.	15·38 c.cm.
0·0296	11·81	—	15·57
0·0409	16·36	—	18·50
0·0518	20·46	—	21·38
0·0663	26·45	—	23·82
0·0990	39·49	—	37·40

It will be noted that the solvent action of the water is important at low concentrations, but gradually decreases, and that in the most concentrated solutions the theoretical absorption by the iron alone is not attained experimentally. It is noteworthy that divalent Ni, Co, and Mn possess a similar power of absorbing NO, and quantitative experiments with these salts are described. This absorption does not appear to have been noticed previously, probably because the solutions do not exhibit the marked colouration which characterises the absorption of NO by ferrous salts. T. M. L.

1727. *Solubility.* I. and II. **E. C. Bingham.** (Amer. Chem. Journ. 37. pp. 549–557, June, and 38. pp. 91–118, July, 1907.)—I. A table is given showing the miscibility of pairs of liquids selected from a list of 50 different substances, 700 pairs altogether being examined. Apart from the first nine substances (Hg, P, S, H_2O, Na, Br, ammonia, formic acid, and silver nitrate) very few cases were recorded in which complete miscibility did not take place either at ordinary temperatures or when heated; in two cases (triethylamine and water, nitrobenzene and CO_2) a lower critical temperature was noted below which the liquids were completely miscible. The 50 substances were arranged in the order of their molecular volumes, and the nine substances which so often showed immiscibility are all characterised by very small molecular volumes; the three substances of higher molecular volume which were found to be poor solvents were sulphuric acid, glycerol, and stannic chloride, all of which are characterised by a great affinity for water, and are, moreover, not easy to obtain completely anhydrous. The presence of a trace of water has a great effect on miscibility; carbon disulphide and ethyl alcohol, usually immiscible, will mix completely down to —14° if pure; benzene and hexane were also found to be completely miscible, and acetone and isobutyl isobutyrate, which mix down to —15°, become immiscible after a short exposure to the air. Formic acid and paraffin are usually immiscible, but might possibly mix if the acid were sufficiently dried. II. The phenomena of solubility are discussed in connection more especially with the existence of a "critical solution temperature," above which two liquids are completely miscible. The analogy of this point with the ordinary "critical temperature" is referred to, and it is shown that there is no sharp boundary between the solution of a liquid in a liquid, of a gas in a liquid, and of a gas in a gas. The attraction of the particles for one another is regarded as responsible for the phenomena of solubility. Evidence is given to show that the attractions vary inversely with the molecular volumes, so that two substances with large molecular volume and small molecular attraction, such as ether and carbon tetrachloride, are more likely to mix than if one of them is replaced by a substance such as water, which has a small molecular volume and large molecular attraction. It is pointed out that the critical pressure is a measure of the molecular attractions at the critical temperature and that the product of critical pressure and molecular volume is substantially constant. T. M. L.

1728. *Molecular Condition of Salts dissolved in a Fused Salt.* **H. W. Foote** and **L. H. Levy.** (Amer. Chem. Journ. 37. pp. 494–506, May, 1907. Contribution from the Sheffield Lab. of Yale Univ.)—Sodium chlorate, which melts at 255°, is easily obtained pure, and is a good solvent for other salts, was found to be a suitable medium for use in cryoscopic experiments, since freezing-point depressions can be determined with an ordinary Beckmann thermometer. The specific heat of the liquid was found to be 0·581, and of the solid 0·281; the latent heat of fusion was 48·4, and the molecular depression $k = 2T^2/q$ was therefore 11,500. Substantially normal values were obtained for the molecular weight of sodium fluoride, chloride, bromide, nitrate, carbonate, and chromate and potassium, cæsium and barium chlorates. In every case but one the experimental was slightly higher than the calculated molecular weight. This might be attributed to slight polymerisation, but is possibly due to a small error in the determination of the molecular depression from the latent heat. The results prove that the dissolved salts have no appreciable tendency towards polymerisation. On the other hand, although dissociation is not indicated by these experiments, it is by no means excluded, since nearly normal molecular weights would be obtained if the solute were very largely dissociated and the solvent somewhat less so, the decreased molecular weight due to the dissociation of the solute being counterbalanced by its effect in repressing the dissociation of the ionised solvent. T. M. L.

1729. *Researches on Inorganic Solvents at Low Temperatures.* **G. Magri.** (Accad. Lincei, Atti, 16. pp. 171–178, Feb. 3, and pp. 518–525, April 7, 1907. —The author describes the apparatus with which he proposes to measure, at various very low temperatures and at different concentrations, the following magnitudes for solutions of substances dissolved in liquid sulphur dioxide and hydrogen sulphide: surface tension, dielectric constant, internal friction, electrical conductivity, density, and molecular weight. He also proposes to study the electrolytic behaviour of the solutions. The second paper gives details of the experiments and an account of some of the results obtained. The boiling-point of hydrogen sulphide at the ordinary pressure is 62°, the freezing-point —88°; at —60° the density is 0·95, and at the same temperature the internal friction is 0·00417 dynes per sq. cm.; the dielectric constant 10·2, the surface tension 25·485 dynes per cm., the electrical conductivity much below 4×10^{-7}. The salts of energetic bases do not dissolve in liquid sulphuretted hydrogen, but compounds of the non-metals amongst themselves (the chlorides of sulphur, of phosphorus, of bismuth, &c.), are fairly soluble in it, and cause a certain conductivity. Iodine is also soluble—a 1·1 per cent. solution at —60° has a conductivity of $1{\cdot}84 \times 10^{-6}$. [See also Abstract No. 1640 (1906).] D. H. J.

1730. *Electrical Conductivity of Solutions of the Alcohols in Liquid Hydrogen Bromide.* **E. H. Archibald.** (Amer. Chem. Soc., Journ. 29. pp. 665–688, May, 1907.)—A large number of organic compounds dissolve in the liquid halogen hydrides to form conducting solutions, but unlike ordinary aqueous solutions, the molecular conductivity (reckoned on the alcohol) decreases rapidly as the dilution increases. In the present paper a detailed account is given of the behaviour of 14 alcohols and phenols dissolved in liquid hydrogen bromide, in which this characteristic is very well marked. There is considerable evidence to show that when an alcohol is added to a liquid halogen hydride an addition compound is formed, and that this is ionised and acts as the conducting body. On these lines an attempt is made to explain the abnormal behaviour of these solutions. Most of the solutions examined show the normal positive temperature-coefficient of conductivity, but in few cases the coefficient is negative, and solutions of thymol and carvacrol appear to have a zero coefficient. Similar observations have been made with other solutions, and the ordinary explanation may be applied in part in the present case. It is suggested that as an additional factor the dissociation of the compounds of solvent and solute may play a part in producing negative coefficients, but this effect is almost certainly present in ordinary aqueous solutions which owe their ionisation to the formation of hydrates. T. M. L.

1731. *Abnormally Great Ionic Mobilities.* **A. Hantzsch** and **K. S. Caldwell.** (Zeitschr. Phys. Chem. 58. pp. 575–584, March 28, 1907.)—Solutions of salts which contain the same anion or kathion as the solvent—pyridonium salts in pyridine, formates in formic acid, acetates in acetic acid, alcoholates in alcohol, and probably bromides in hydrogen bromide and sulphates in sulphuric acid—exhibit abnormally high conductivity. This is not due to increased ionisation, but to an apparent increase of ionic mobility. This depends on an interaction of the solute with the solvent. For example, the pyridonium kathion $\overset{+}{NC_5H_{11}}$ liberates a hydrogen ion $\overset{+}{H}$, and gives rise to a molecule of the base NC_5H_{10}, which forms the solvent. The hydrogen ion is thus handed on from one molecule to another by a chemical rather than by a purely physical process of ionic migration, and the mobility observed is not that of the pyridonium, but of the hydrogen ion. So also in the case of a formate in formic acid the observed high mobility may be really that of a hydrogen ion liberated from the acid of the solvent. It is noteworthy that methyl-pyridonium iodide $NC_5H_{10}(CH_3)I$, which cannot liberate a hydrogen ion in this way, has a normal mobility. T. M. L.

1732. *Ionic Mobility in Dilute Solutions.* **H. Jahn.** (Zeitschr. Phys. Chem. 58. pp. 641–658, April 9, 1907. Phys.-Chem. Inst. d. Univ., Berlin.)—A redetermination of the transport-number of hydrogen in hydrogen chloride has given the values 0·833 at 18°, 0·846 at 0°, and 0·817 at 30°. These observations are in agreement with those of Noyes and Sammet (0·828 at 30°), but give a lower value than the early determinations of Bogdan. It will be noticed that the transport value decreases as the temperature rises. The following additional values were obtained.

	0°	18°	30°			
NaCl	0·388	0·395	0·405	Bogdan	18°	0·396
				Bein	96°	0·453
AmCl	0·490	0·493	0·496	Hittorf	10°	0·486
				Bein	18°	0·499
				Bein	22°	0·487
KCl	0·495	0·494	0·498	Bogdan	18°	0·497
$AgNO_3$	—	—	0·482	Berliner	18°	0·471
				Hittorf	18°	0·474
				Nernst	18°	0·472
				Bein	18°	0·475
$BaCl_2$	0·562	—	0·555	Bukschnewski	18°	0·558
K_2SO_4	—	0·494	—	Noyes	25°	0·496
				Masson		0·535
Na_2SO_4	—	0·391	—	Hittorf N/4		0·368
				Masson		0·433
$CdSO_4$	—	0·387	—	Goldlust		0·387
$MgSO_4$	—	0·387	0·388	Hittorf N/25	18°	0·344
				Bein N/40		0·459
H_2SO_4	—	0·845	0·838			

The values for the sulphates increase somewhat rapidly with dilution; the figures quoted are for $v = 240$ (approx.), and are in agreement with Hittorf's values for concentrated solutions; the observations of Masson and Bein appear to be too high. In the case of sulphuric acid the value remains practically constant at 0·824 from $v = 16$ to $v = 192$, $T = 18°$, and then rapidly increases in more dilute solutions; a similar change occurs when $T = 80°$, and it is suggested that the lower value corresponds to the behaviour of sulphuric acid as a monobasic acid $H_2SO_4 \rightleftarrows \overset{+}{H} + \overset{-}{HSO_4}$, whilst the higher value is due to the further dissociation $H_2SO_4 \rightleftarrows 2\overset{+}{H} + \overset{=}{SO_4}$. The lower value is very near to the limiting value for HCl and HNO_3. Values are also given for aqueous-alcoholic solutions of HCl, NaCl, KCl, and $BaCl_2$.

T. M. L.

1733. *Ionic Mobilities in Water.* **F. Kohlrausch.** (Zeitschr. Elektrochem. 13. pp. 333–344, June 21, 1907.)—A criticism of recent work on ionic mobilities. In several instances it is possible to check against one another the data for different salts by making use of the law of independent migration of the ions. When applied to the transport-numbers this usually exhibits errors of only a very few units in the third decimal; when applied to molecular conductivities the additive law holds good within a few tenths of a unit. In the case of polyvalent ions the treatment of the experimental material is much more difficult, and in compounds, such as $BaCl_2$ and H_2SO_4, it is not easy to decide what are the ions which take part in the electrolysis.

T. M. L.

1734. *Liquid Volume of a Dissolved Substance.* **J. S. Lumsden.** (Chem. Soc., Journ. 91. pp. 24–35, Jan., 1907.)—Experiments were made in order to determine whether a solid, liquid, or gas occupies a definite volume when dissolved, independently of the nature of the solvent, provided the latter exerts no chemical action on the solute: the solutes used were naphthalene, phenylacetic acid, thymol, dichlorobenzene, *o*-nitrophenol (solids); chloroform and bromine (liquids); the solvents were benzene, toluene, carbon tetrachloride, chloroform, and quinoline. It was found that the molecular volume of the solute increases with the temperature, but does not show any marked change when the solution passes the normal melting-temperature of the solute. In some cases (phenylacetic acid and naphthalene dissolved in toluene) the molecular volume of the solute is identical with the molecular volume of the melted solute within the limits of temperature within which a direct comparison can be made; in other cases the two volumes differ in one direction or the other, but *by an amount that is independent of the temperature.* Aqueous solutions were excluded from the investigation owing to the general occurrence of chemical interaction between the solvent and solute.

T. M. L.

1735. *Depression of the Freezing-point of Aqueous Solutions of Hydrogen Peroxide by Potassium Persulphate and other Compounds.* **T. S. Price.** (Chem. Soc., Journ. 91. pp. 531–536, April, 1907.)—Potassium persulphate causes a less depression in aqueous hydrogen peroxide than in water, and hence it may be concluded that an unstable compound is formed in solution; similar results hold for potassium sulphate and hydrogen peroxide. The molecular depression caused by sulphuric acid is greater in hydrogen peroxide solutions than in water; this confirms the results of Jones and Murray (Amer. Chem. Journ. 30. p. 205, 1903), which show that sulphuric acid is dissociated more in hydrogen peroxide than in water.

D. H. J.

1736. *Dissociation of Saturated Solutions of an Electrolyte in different Solvents, and of Solutions in which the Normal Ratio of Distribution Exists.* **J. J. van Laar.** (Zeitschr. Phys. Chem. 58. pp. 567–574, March 28, 1907.)—Walden has shown that the degree of dissociation of the salt $N(C_2H_5)_4I$ is practically the same in a large range of solvents, provided that saturated solutions are considered in every case. This relationship is now established on a theoretical basis, and is shown to be a special case of a general law applicable to solutions which are in equilibrium, not with the solid solute, but with a solution of given concentration in another (non-miscible) solvent.

T. M. L.

1737. *Colour of Aqueous Solutions of Cupric Chloride in Relation with Electrolytic Dissociation.* **M. Nozari.** (Accad. Sci. Torino, Atti, 42. 6. pp. 288–289, 1906–1907.)—The author has determined the degree of dissociation of cupric chloride in solutions of various strengths at temperature intervals of 10° between 20° and 90°, and has found that the dissociation diminishes with rising temperature; the reason for the increased conductivity accompanying rise of temperature must therefore be sought in the greater mobility of the ions rather than in their increased number. The diminution in the dissociation enables us to retain Ostwald's theory to explain the variation of colour observed when aqueous solutions of cupric chloride are warmed.

D. H. J.

1738. *Dissociation of Lithium Silicates.* **E. Derome.** (Comptes Rendus, 144. pp. 1116–1118, May 21, 1907.)—The author has determined the amount of Li_2O lost by lithium silicates when heated *in vacuo*, the silicates being introduced, in a platinum boat, into a porcelain tube, heated in an electric resistance furnace. Lithium glass, prepared by maintaining a mixture of silica and lithium carbonate for some hours at 900° C. in a current of hydrogen, and having initially the composition SiO_2, 2·56 Li_2O, on being heated to 1,100° was found to finally, after 29·5 hours, have the following composition: SiO_2, 1·95Li_2O, the rate of dissociation showing marked diminution in the vicinity of SiO_2, 2Li_2O. A perfectly pure crystalline specimen of SiO_2, Li_2O when heated to 1,300° for 67 hours left the following residue: 3·54 SiO_2, Li_2O, the rate of dissociation decreasing continuously, but the decrease becoming more rapid as the residue approached the composition 5SiO_2, Li_2O.

W. H. St.

1739. *Electrolytic Dissociation of Fused Salts.* **K. Arndt.** (Ber. Deut. Chem. Gesell. 40. pp. 2937–2940, 1907. Chem. News, 96. p. 60, Aug. 2, 1907. Abstract.)—The use of boric acid anhydride, the conductivity of which is only 0·000021 at 900° C., is recommended as a solvent in measuring the conductivities of fused salts. Experiments with solutions containing varying proportions of sodium metaphosphate dissolved therein show that at 900° the conductivity is proportional to the viscosity and that the product of conductivity and viscosity is constant, while calculated for the same viscosity the equivalent conductivity is independent of the concentration, indicating the probable complete dissociation of the sodium metaphosphate. The same appears to be also true for solutions of KCl and NaCl, the assumption being supported by the fact that with these, increase in conductivity with the temperature is represented by a straight line. With salts of divalent metals the conductivity curve first rises rapidly with temperature, then more slowly, and finally approximates to a straight line, whence it is concluded that the dissociation is not complete at the melting-point, but only after the temperature is further raised. **W. H. St.**

1740. *Ionisation in Solutions and Two New Types of Viscosity.* **W. Sutherland.** (Phil. Mag. 14. pp. 1-35, July, 1907.)—In a previous paper on Ionisation it was shown that the theory of the conductivity of electrolytic solutions is complicated by the entry of the dielectric capacity of the solvent and of the ions. In the present paper other complications are treated which lead the author to a view of solutions fundamentally different from that currently held. Some of his chief conclusions may be summarised as follows: (1) The ionisation of all ordinary solutions at all strengths is complete. This is proved by showing that the fraction currently called the degree of ionisation really originates in a resistance which the ions offer to one another's motion, because of their forming with the solvent, through their electric action on one another, a medium which offers a special viscous resistance to the motion of each individual ion. (2) This is one new type of viscosity of electric origin. (3) But the charge of each ion causes electric induction through the surrounding solution, and with this is associated a second new type of viscosity, also of electric origin. (4) These, with the ordinary viscosity of the solution, give three resistances to the motion of an ion. (5) When the sum of these is equated to the electric driving force, a formula is obtained for the molecular specific conductivity. This is tested by comparison with experimental results of very wide range, especially those of Walden for non-aqueous solutions, those of Kohlrausch for aqueous at ordinary temperatures, and those of Noyes and Coolidge for aqueous at high temperatures. (6) Incidentally some insight has been obtained into the properties of the effective force which keeps a solute completely ionised. It is shown that the dynamical theory already given for diffusion of non-electrolytes joins on consistently with that developed here for conduction, if the same empirical allowance for slipping is made in each. (7) The equations for conduction and diffusion lead to values of the radius of the hydrogen molecule in good agreement with that yielded by the kinetic theory of gases, namely, 10^{-8} cm. (8) The current theory of solutions will need to be entirely rewritten. The idea of partial ionisation, while it can give a formal qualitative account of the chief phenomena of solutions, being dynamically wrong, cannot furnish a correct quantitative correlation of their properties. E. H. B.

1741. *Formation of Calcium Cyanamide and of Calcium Carbide.* **E. Rudolfi.** (Zeitschr. Anorg. Chem. 54. 2. pp. 170–184, June 17, 1907. Inst. f. physikal. Chemie d. Univ., Göttingen.)—The publication of the experiments of Kühling, Bredig, Foerster, and Jacoby [see Abstracts Nos. 1089B (1906) and 780A and 782A (1907)] induces the author to give an account of his unfinished researches. In the first part of the paper he describes the experiments on the formation of calcium cyanamide, starting from commercial calcium carbide 82 per cent. and nitrogen; the latter he purified and dried. The boat in his tubular electric furnace of porcelain contains 4 gm. of CaC_2; temperatures are measured with the aid of thermo-couples. Below 700° C. the carbide absorbed only 0·6 per cent. of N. The addition of $CaCl_2$ to the carbide increased the nitrogen absorption considerably, to 18 per cent. at 1,000°, but only when the temperature rose above 760°; according to Ruff and Plato, $CaCl_2$ melts at 780°. Mixtures of $CaCl_2$ with CaF_2 (melting-point 660°) and further with CaI_2 (melting-point 590°), also improved the efficiency, though less than in the case of $CaCl_2$. It would appear that a high temperature is favourable to the formation of $CaCN_2$. The nature of the effect of the additions is not settled. The nitrogen should be dry, because water vapour decomposes the carbide. In the second part the author heats soot, lime, and nitrogen in a tubular electric carbon furnace in order to prepare the calcium cyanamide directly; according to the Cyanidgesellschaft, of Berlin, the formation takes place at 2,000° C. A Wanner pyrometer was used. According to Rothmund, the reaction—

$$CaO + 3C = CaC_2 + CO$$

is in equilibrium at 1,620°, when the partial pressure of the CO amounts to 0·2 atmo., and at a lower temperature when the pressure is lower; according to Moissan no carbide is obtained below 1,775° C. Nernst's formula would, from the Rothmund-Forcrand data, give equilibrium at 1,990° C. The author observed that the carbide formation did not begin until a temperature of 1,800 or 1,819° was reached, and that calcium cyanamide and calcium carbide were always found together, or they were both absent. H. B.

1742. *Indirect Potential Determination with Unattackable Electrodes.* **R. Luther.** (Zeitschr. Elektrochem. 13. pp. 289–294, June 7, 1907.)—The e.m.f. of a reversible cell may be utilised for determining the free energy of an oxidation-reduction process. If the electrode is not attacked, the process is not reversible, and additions are made to the electrolyte with the object of rendering the process more reversible. As additions Loimaranta and Abegg [see Abstract No. 545 (1907)] have recommended iodide or iodine, which the author considers unsuitable. A potential may be constant and reproduceable and yet yield a wrong e.m.f., as the case of the hydrogen-oxygen couple shows. The best criterion is the concentration correctness, *i.e.*, the potential must change with the concentration of the substances concerned in the electrode processes. Further, the potentials must agree with the equilibrium constant of Roebuck; Loimaranta's experiments with arsenic acid do not fulfil these conditions. Substances suitable as depolarisation catalysers or for intermediate potential determinations should depolarise well and be correct as to concentration at small concentrations; should react rapidly with the oxidation-reduction mixture; and neither of the two oxides should be entirely absent at equilibrium. The author discusses these latter conditions. H. B.

1743. *Nernst's Theory and Electrocapillarity.* **J. Guyot.** (Journ. de Physique, 6. pp. 530–550, July, 1907.)—The author considers the work of Couette [Abstract No. 1892 (1900)], Rothé [Abstract No. 180 (1902)], Gouy [Abstracts Nos. 168 and 1484 (1903)], and others, in reference to Nernst's osmotic theory of cells. It is shown that this theory is incompatible with the hypothesis derived from Helmholtz's theory of the double layer, although this hypothesis is used by Rothé [Abstract No. 1970 (1901)] in arriving at a conclusion in accord with Nernst's theory. Rothé's experiments do not lead to any certain conclusions concerning the theory of electrodes, because the capillary electrometer does not give the true p.d. at the contact of the mercury. The accord, obtained with liquid chains having different ends, between the calculated and observed e.m.f.'s, gives no support to Nernst's theory concerning the p.d.'s at the contact. Only liquid chains with identical extremities [see Abstract No. 1781 (1907)], where the e.m.f. is independent of any consideration relative to the electrodes, can add to the experimental confirmation received by this theory from a study of diffusion phenomena. The results of an examination of such chains are to be given later. T. H. P.

1744. *Difference of Potential between Two Electrolytic Solutions.* **J. Guyot.** (Comptes Rendus, 144. pp. 1085–1087, May 18, 1907.)—If Nernst's solution-pressure theory is correct, then in a cell made up of two solutions L_1, L_2 of electrolytes having a common anion, and containing two mercury electrodes covered with a mercurous salt capable of giving the same anion, the sum of the p.d.'s at the junction of the electrodes is given by the formula—

$$e = (\mathrm{RT}/ep) \log (\omega_1/\omega_2) \text{ ....} (1),$$

where ω_1, ω_2 are the osmotic pressures of the anion in each of the solutions. It follows that the e.m.f. of the cell is—

$$\mathrm{E} = (\mathrm{RT}/ep) \log (\omega_1/\omega_2) + \mathrm{L}_1/\mathrm{L}_2.$$

With two solutions equally concentrated with respect to the anion, $\omega_1, = \omega_2$, and $e = 0$, and hence $\mathrm{E} = \mathrm{L}_1/\mathrm{L}_2$. Hence, if (1) is correct, we have a very practical method of measuring p.d.'s between electrolytes of the same molecular concentration and the same ion. The author applies it to several electrolytic couples with divalent anion and univalent kathion, such as Na_2SO_4. Taking into account the fact that the ratio of the number of molecules dissociated to the total number of molecules is not the same in sulphuric and in sulphated solutions respectively, there is a very fair agreement between calculation and observation. E. E. F.

1745. *Iron-Nickel Oxide Accumulators.* I. *Nickel Peroxide Electrodes.* **F. Foerster.** (Zeitschr. Elektrochem. 18. pp. 414–484, July 12, 1907. Laborat. f. Elektrochemie u. physikal. Chemie d. techn. Hochschule, Dresden. Rev. Électrique, 8. pp. 98–108, Aug. 80, 1907.)—Edison described the active nickel oxide of his cell as peroxide, NiO_2, without giving analyses. Zedner [Abstract No. 1490 (1906)] denied the existence in the cell of any higher oxide than Ni_2O_3. Bellucci, Clavari, and Rubegni (Gazzetta Chim. Ital. 86. 1. pp. 1 and 58) consider that the oxides are NiO_2 and NiO and mixtures of these two, and that, in the amorphous state at any rate, there is no oxide Ni_2O_3. The author assumes with Engler that the oxidation of metallic salts first converts MO into the primary oxide MO_2; this MO_2 may combine with MO to M_2O_3, or split some oxygen off, and yield thus M_2O_3. The latter reaction is so quick in the case of Fe and Cr, that we do not know the MO_2; with Ni, however, the primary oxide NiO_2 may be isolated, though it decomposes rapidly. In unused Edison nickel oxide electrodes the author finds $Ni(OH)_2$. Charging these electrodes, throwing the contents of a pocket quickly into CO_2, and decomposing the oxide with H_2SO_4 and H_2O_2, he obtains more active oxygen than would correspond to Ni_2O_3 and he assumes therefore, that some NiO_2 is present. In the dried electrode he finds, however, only Ni_2O_3 with 1·1 or 1·8 H_2O, which would thus be stable also in the amorphous state (contrary to Bellucci). The potential of the charged NiO_2 electrode drops quickly to that of the Ni_2O_3, of the first discharge stage, and afterwards more slowly, and finally very rapidly, to the potential of the second discharge stage. This latter stage corresponds to a lower oxide, intermediate between NiO and Ni_2O_3. Analytical proofs are not offered; but the author asserts that the occlusion of oxygen cannot explain the character of the discharge curves as Zedner had assumed. H. B.

1746. *Electrolytic Catalysis by Vanadium Salts.* **R. Luther.** (Zeitschr. Elektrochem, 13. pp. 437–439; Discussion, pp. 439–440, July 19, 1907. Paper read before the 14th Hauptversamml. d. deutsch. Bunsen-Gesell., Hamburg, May 10, 1907.)—A mixture of potassium chlorate, potassium bromide and carbon tetrachloride remains colourless when shaken up, but turns brown when the $KClO_3$ is reduced to ClO_2 by adding some solution of vanadic salt. Likewise a couple consisting of zinc, zinc sulphate, diaphragm, chloric acid, platinum, is soon polarised by hydrogen, the e.m.f. dropping from 1·8 to 0·6 volt, because the chloric acid is a sluggish oxidising agent. But when vanadic acid is added the e.m.f. rises to 2·2 volts. The author, who has experimented in conjunction with Rutter and Kutscheroff, describes these reactions as "activations, inductions, or coupling phenomena." The reduction of the chloric acid takes place in steps, like the reduction of chromic acid. **F. Foerster** having pointed out, in the *discussion*, that depolarisations generally occur at the surface of the electrodes, the author remarked that this was a case of catalysis by a solution. H. B.

1747. *Two New Potentials,* $NO_3' \longrightarrow NO_3$, *and* $Au^{\cdot} \longrightarrow$ *Au-metal.* **R. Abegg.** (Zeitschr. Elektrochem. 13. p. 440; Discussion, p. 441, July 19, 1907. Paper read before the 14th Hauptversamml. d. deutsch. Bunsen-Gesell., Hamburg, May 10, 1907.)—Discharge potentials of oxygenous anions are hardly known, because the discharged ion is generally O″. Neustadt has, however, determined the equilibrium $AgNO_3 + I \rightleftarrows AgI + NO_3$ in a solution of CCl_4, and found the potential of NO_3' equal to + 1·28 volts, while Pick's thermochemical calculations (Dissertation, Breslau, 1906) yield the value 1·1 volts. Campbell has investigated the potential of gold electrodes depolarised with Au_2O in nitric acid, in which the oxide is slightly soluble to auronitrate when the acid is sufficiently concentrated; the potential against the normal hydrogen electrode is about 1·46 volts. The solubility of the gold oxide in nitric acid seems to be constant, while according to **Haber** the platinum oxides cannot be said to have any definite solubility in this acid. H. B.

1748. *The Iron Potential and Passivity of Metals.* **F. Haber** and **W. Maitland.** (Zeitschr. Elektrochem. 13. pp. 309–310, June 7, 1907. From the Inst. f. physikal. Chemie u. Elektrochem. d. k. techn. Hochschule, Karlsruhe.)—Calculating Faust's potential of spongy iron in caustic alkali [see Abstract No. 1247 (1907)] for the decinormal electrode, the authors point out that this value, —1·18 volts, agrees with Foerster's —1·20 volts. They therefore adhere to the oxide-film theory of passivity of Haber and Goldschmidt [see Abstract No. 681 (1906)], and consider that Müller and Königsberger in their experiments on the reflective power of iron always dealt with an iron which remained covered with an oxide film, in spite of a weak kathodic polarisation. This potential had so far not been observed with massive iron; but it is found when the alkali solution is hot, while observations are generally made in the cold. The other iron potential found by Faust, —0·88 volt, may correspond to another oxide, stable only in very strong alkali. H. B.

1749. *Discharge of the Anion of Acetic Acid.* **G. Preuner.** (Zeitschr. Phys. Chem. 59. pp. 670–681, July 16, 1907.)—The author has made a chemical analytical examination of the gaseous products of electrolysis of acetic acid in a N/2 acetic acid and N/2 potassium acetate, employing different current strengths, and measured the anode potential against the hydrogen electrode. The estimation of the amounts of CO_2 and ethane in the gases evolved showed that when smooth platinum electrodes were employed no acetate ions were discharged for a considerable range of potential above 1·7 volts. The discharge of the anions takes place at a fairly definite potential, and the $CO_2 + C_2H_6$ per cent. anode potential curve showed a break, and this break occured at the same potential as in the decomposition potential curve. This potential is about 2·5 volts, and not 2·1 volts as previously observed. When platinised Pt electrodes were employed only very small amounts of CO_2 and C_2H_6 were found. The probable reason for this is that the main anode reaction is the secondary evolution of oxygen, due to the reaction of the acetate ion with water. F. J. B.

1750. *Decomposition-potential of Acetic and Propionic Acids.* **G. Preuner and E. B. Ludlam.** (Zeitschr. Phys. Chem. 59. pp. 682–690, July 16, 1907.) —The gaseous products of the electrolysis of propionic acid (½ mol. propionic acid + ½ mol. potassium propionate) were examined, and the anode potentials measured against the hydrogen electrode. It was found that butane was evolved only at a potential of above 2·7 volts. Measurements of the decomposition potentials of acetic and propionic acids gave 2·54 volts for acetic acid and 2·58 volts for propionic acid. The values observed by Bose, viz., 2·05 volts for acetic acid and 2·07 volts for propionic acid, were not observed. The break in the decomposition potential curve was obtained quite definitely when the logarithm of the current strength was plotted against the anode potential. This confirmed the theoretically probable relationship between current and potential. At higher current densities and with platinised electrodes the acetic acid was oxidised, probably by the formation of oxides of platinum. F. J. B.

1751. *Electrolytic Precipitation of Zinc.* **R. C. Snowdon.** (Journ. Phys. Chem. 11. pp. 369–381, May, 1907.)—In studying the electrolytic precipitation of zinc the following variables were taken into account: Concentration, degree of acidity and alkalinity, reducing agent, current density, temperature, and speed of rotation of the kathode. The results obtained were as follows: Good deposits of zinc may be obtained from acid or alkaline solutions even at such high current densities as 60 amps./dm.². In general, the alkaline solutions begin to give bad results at a lower current density than the acid solutions. Against this must be set the facts that the deposits from the alkaline solutions are more finely crystalline than those from the acid solutions; that the current efficiency is higher; and that the resistance of these solutions, and consequently the voltage across the terminals, can be made very low for any given current density. Increasing temperature or concentration increases the coarseness of the crystals, whereas increase in the current density decreases the size of the crystals, as also does the presence of formaldehyde. The rate of stirring (rotating kathode) has a greater effect on the limiting current density at which the deposit begins to become bad than all the other factors combined. T. S. P.

1752. *Polarisation Voltages of Silver Nitrate Solutions.* **J. A. Wilkinson and H. W. Gillett.** (Journ. Phys. Chem. 11. pp. 382–391, May, 1907.)—The polarisation voltages of silver nitrate solutions of different strengths were determined by measuring the counter-e.m.f. given by the cell after it had been polarised by a charging current, the results being as follows: The polarisation voltage of acidified silver nitrate solutions may be made to vary from 0·625 to 1·05 volts; it varies with variations of temperature, silver nitrate, nitric acid and water. It increases as the concentration of the silver nitrate decreases, the concentration of the nitric acid being kept constant, whereas it decreases when the concentration of the silver nitrate is kept constant and that of the nitric acid decreased, or when the concentrations of the silver nitrate and nitric acid are decreased in the same ratio. The temperature-coefficient is approximately 0·8 millivolt per 1° over a fair range of compositions and temperatures. When measured against a sulphuric acid—mercurous sulphate—mercury electrode the p.d. between silver and the electrolyte is decreased slightly by the addition of nitric acid, while the p.d. between silver peroxide and electrolyte is apparently increased a good deal. The abnormal result with the silver electrode may possibly be due to a change in the p.d. between the solutions, caused by the addition of the nitric acid. The data do not show whether, or when, the product formed at the anode changes from peroxide to oxygen. T. S. P.

1753. *Electrolytic Reduction.* III. **H. D. Law.** (Chem. Soc., Journ. 91. 748–760, April, 1907.)—The products of electrolytic reduction of the aromatic aldehydes *in alkaline solution* are compounds of the hydrobenzoin type, but this reaction is completely altered when a methyl group is substituted in the ortho- or meta-position of the benzene nucleus. In the latter case resinous compounds are obtained. The resinifying effect of a single substitution may, however, be neutralised by the introduction of a second group in a similar position on the opposite side of the nucleus. Thus with 3 : 5 dimethylbenzaldehyde a crystalline product is obtained, whilst 2 : 4 dimethylbenzaldehyde yields 40 per cent. of resin. *In acid solution* the products differ greatly at different temperatures; thus in cold solutions primary alcohols are obtained to a large extent, but at 40° the product is of the hydrobenzoin type. D. H. J.

1754. *Quantitative Separation of Iron from Titanium and from Aluminium. Application of a Membrane to Quantitative Electrolytic Analysis.* **G. Magri and G. Ercolini.** (Accad. Lincei, Atti, 16. pp. 331–336, March 3, 1907.)—The solution containing the three substances is placed in a platinum dish, which serves as kathode. The anodic vessel, which dips into the kathodic liquid, contains a dilute solution of caustic soda; the bottom of the vessel is a sheet of parchment. The electrolysis, which is conducted under a voltage of 110 and a current density at the kathode, ND_{100}, of 0·39, rising finally to 0·78, may occupy 24 hours; the anodic liquid is kept alkaline by adding caustic soda from time to time, and the kathodic liquid is prevented from becoming too acid by the addition of tartaric acid. The iron is thus deposited in a compact adherent form. The subsequent separation of the Al and Ti is then simple. For further details the original must be consulted. D. H. J.

1755. *Electrolytic Applications of Alternating Currents.* **A. Coppadoro.** (Gazzetta Chim. Ital. 36. 2. pp. 698–728, 1906.)—The first part of this paper deals with the industrial use of alternating currents in electrolysis, the second with the aluminium valve-cell or rectifier, and the third with the behaviour of nickel electrodes towards alternating currents. I. Using ordinary alternating currents with a periodicity of 42 per sec. the process of Richards and Roepper (Brit. Pats. 9,687 and 9,688 of 1898) for the preparation of insoluble compounds cannot be applied to the manufacture of the sulphides of Zn, Cd, &c., the yields being very small. With electrodes of lead and solutions of sulphuric acid, however, these alternating currents give good yields of lead sulphate; the best energy yield is obtained with 50 per cent. acid, the difference of potential at the electrodes not exceeding 4 volts. The action on the lead seems to depend on the formation of persulphuric acid during the anodic phase. II. The experiments with the Al rectifier show that by this means it is impossible to resolve the alternating current completely into two equal and opposite direct currents; two new alternating currents are always obtained in which one phase has an intensity much greater than that of the other, the ratio between the two intensities being variable. III. With sulphuric acid having a concentration between 5 and 40 per cent., Ni is dissolved almost quantitatively under the action of an alternating current when the density of the latter exceeds 50 amps./cm.^{2}. With densities lower than this value, the condition of the surface of the electrodes exerts a considerable influence on the amount of metal dissolved. With 50–60 per cent. sulphuric acid, the yield of dissolved Ni first increases to a maximum with augmentation of the current density and subsequently diminishes considerably, indicating that the metal becomes passive; at the same time, oxygen appears mixed with the hydrogen evolved. The amount of Ni dissolved is increased by the presence in the acid of oxidising agents such as potassium permanganate or hydrogen peroxide, or even by the passage of air through the electrolyte. The current-yield of Ni dissolved in other acids, such as hydrochloric, nitric, and acetic acids, is also high. Using potassium chloride solution as electrolyte, the current-yield of dissolved Ni never exceeds about 10 per cent.; hydrogen unmixed with chlorine is evolved, nickel hydroxide is precipitated, and the electrodes become coated with a thin, black film of finely-divided Ni. Addition of potassium hydroxide to the chloride lowers the yield considerably, and increase of the current density then causes further diminution in the yield, the Ni exhibiting the passivity it presents in alkaline solutions under the action of a direct current. When sodium nitrate solution is used the passivity is perfect, no Ni being dissolved or gas evolved; with sodium chlorate the passivity is almost perfect, but with potassium sulphate slightly more Ni is dissolved, nickel hydroxide being also formed. T. H. P.

1756. *Anodic Disturbances in the Electrolysis of Fused Alkaline Earth Chlorides.* **K. Arndt** and **K. Willner.** (Ber. Deut. Chem. Gesell. 40. pp. 3025–3029, 1907. Chem. News, 96. p. 84, Aug. 16, 1907.)—When fused barium chloride is electrolysed in a porcelain crucible heated by kryptol, with a carbon anode and an iron-wire kathode, the resistance rises and the evolution of chlorine is stopped. The same observation is made with $SrCl_2$, but not with $CaCl_2$. The different behaviour is not explained by the lower melting-point of the $CaCl_2$ ($CaCl_2$, 774° C.; $SrCl_2$, 873°; $BaCl_2$, 950°), for in a superheated bath of $CaCl_2$ the electrolysis proceeds without disturbance, nor by the different conductivities of the fused salts. But it was found that in the $BaCl_2$ and $SrCl_2$ the carbon anode becomes surrounded by a salt crust which contains silica. The liberated alkali attacks the crucible and takes up silica, which is fairly soluble (4 per cent.) in calcium chloride, but less soluble in the other chlorides. When $SrCl_2$ was melted in a magnesia crucible the resistance rose momentarily only, and a compact strontium was obtained with currents of 85 amps. at 1·18 volts. But when a small amount of silica was added to the bath, the electrolysis was soon stopped. The alkaline earths themselves are soluble in their chlorides. H. B.

1757. *Electrolysis of Thorium Nitrate.* **O. Angelucci.** (Accad. Lincei, Atti, 16. pp. 196–198, Aug. 4, 1907.)—By electrolysis of thorium nitrate solutions the two chief constituents of radio-thorium are separated, thorium X being deposited on the anode and a scarcely appreciable film of thorium A on the kathode. With solutions of 60 to 70 per cent. thorium nitrate, a considerable quantity of nitrogen gas is liberated. W. H. St.

1758. *Effect of Sulphuric Acid on Deposition of Metals, using Mercury Kathode and Rotating Anode.* **L. G. Kollock** and **E. F. Smith.** (Amer. Chem. Soc., Journ. 29. pp. 797–806, June, 1907. Contribution from the John Harrison Lab. of Chemistry.)—The presence of sulphuric acid in solutions of zinc, copper, cadmium, iron, cobalt, and nickel sulphates retards the deposition of the metals to a greater or less extent. The retardations in the various cases are expressed graphically in the original paper. The conditions are given under which, when a mercury kathode is used, the following separations may be effected: Cd from Al or Mg or Cr, and Cu from Al.

T. H. P.

1759. *Use of Tin as Kathode for Electrolytic Estimation of Zinc, Copper, Silver, Cadmium and Zinc.* **L. T. Sherwood** and **G. Alleman.** (Amer. Chem. Soc., Journ. 29. pp. 1065–1074, July, 1907.)—The authors have investigated the use of tin in place of platinum for the ordinary dish kathode. A rotating Pt spiral anode was used in each case. The surface of the dishes had to be scoured bright after use, and consequently lost a little in weight in cleaning, but with reasonable care they last indefinitely. The solvent action of electrolytes on the tin was obviated by certain precautions in each case, generally by arranging everything ready for the current to pass immediately the electrolyte was put into the dish. Solutions which have no solvent action on the tin dishes may, during the progress of an analysis, be heated in them upon a sheet of asbestos, or upon an electric stove, without fear of oxidising the tin. *Zinc.*—Good results were obtained with the sodium acetate-acetic acid electrolyte. With caustic soda the results were not so satisfactory. *Silver.*—It was necessary to add oxalic acid to the cyanide solution before good deposits were obtained. Unless rather low currents were used the deposits tended to be spongy, but if a little clear gelatine solution was added, 1¼ amps. could be used. *Cadmium.*—Sulphuric acid electrolyte gave good results. *Copper* was the most difficult metal to deposit satisfactorily, and considerable manipulation was necessary. The only satisfactory electrolyte was the ammonium oxalate-oxalic acid one, to which a little gelatine had been added. *Nickel.*—The results were satisfactory, using either the ammonium sulphate and hydroxide electrolyte, or the ammonium acetate and hydroxide electrolyte. T. S. P.

1760. *Passivifying, Passivity, and Activifying of Iron.* **H. L. Heathcote.** (Soc. Chem. Ind., Journ. 26. pp. 899–916; Discussion, pp. 916–917, Aug. 31, 1907. Paper read before the Birmingham and Midland Section.)—The author has carried out a number of experiments on the passivifying of iron, from which he concludes that the process is always electrolytic, and that when no external current is employed, current is generated from one part of the surface to the other. The process is considered as occurring in the following manner: When iron is immersed in a solution some of the metal passes into solution forming ferrous ions, or the ferrous ions in the metal pass into the solution, from all parts of the surface. The solution pressure of the iron will not be the same at all parts of the surface, consequently local electric currents will arise, and if the solution will act as a depolariser at the kathode of the local current, the current may persist until it effects passivification of the iron at the local anode. If the solution is not a very vigorous hydrogen depolariser, or if its action on active iron is vigorous, passivifying may require quite a considerable time; various stages of semi-passivity will succeed one another until in some spots the passivification may become complete. If the rate of action of the solution on the passive particle is small, and if the solution can depolarise it, currents between the passive part and adjacent active iron will not activify the passive area, but may passivify the active part. This would explain the establishing of passivity over the whole surface. As to the cause of passivity itself, there is no theory which will explain these results and the results of others so well as that which postulates a layer of magnetic oxide. The ions $H^{\cdot}$ and OH' can be liberated even from aqueous solutions of salts which contain no oxygenated anions, and the results obtained by the author go to show that it is the ion OH' which effects passivity, and it is certain that this state is due to the establishment of a solid phase. A full bibliography is appended. A. F.

1761. *Metal Fog, Current Yield, and Theory of the Deposits obtained in the Electrolysis of Molten Salts.* **R. Lorenz.** (Zeitschr. Elektrochem. 18. pp. 582–585, Aug. 28, 1907. From the Laborat. f. physikal. Chemie u. Elektrochemie des Eidg. Polytechnikums, Zürich.)—In the electrolysis of molten salts the current yields are often seriously impaired by the formation of a metal fog at the kathode; this fog spreads through the electrolyte, unless diaphragms are used, and recombination of the metal with the gas evolved at the anode takes place. The formation of the fog is not due to the electrolysis or to electrode disintegration, the electric current being unnecessary, as shown by the following experiment: If lead chloride is melted in a hard glass tube and a piece of lead thrown into the melt, it sinks to the bottom of the tube and forms a globule with bright surface. After a few seconds, however, the globule begins to throw out, almost explosively, a metallic fog, which soon spreads through the melt and makes it dark-coloured. The melt containing the fog is transparent in transmitted light, but iridescent and opaque in reflected light. The author considers the metal to be in the same condition as is the gold in ruby glass. If, now, a salt such as KCl is added to the melt, the latter immediately clears and the lead again forms a globule with bright surface. Quantitative determinations of the current-yields obtained by the electrolysis of molten lead chloride and iodide, and of cadmium chloride, containing varying quantities of the corresponding Na, K, and Ba salts, show that the addition of these latter increases considerably the current-yield—*e.g.*, the current-yield of Cd with the pure chloride is *nil*, but a mixture of 8 molecules of $CdCl_2$ and 9 of KCl gives a 78·6 per cent. yield of Cd. The result is not due to the lower melting-point of the mixtures preventing the formation of the metallic fog, since all the comparative experiments were carried out at the same temperature; it is due to the action of the added salt in clearing the melt. The results with Na, K and Ba chlorides show that the action of these salts is proportional to their molecular weight. T. S. P.

1762. *Passive Phenomena with Magnesium.* **R. Lohnstein.** (Zeitschr. Elektrochem. 13. pp. 613–614, Sept. 6, 1907.)—Magnesium is rapidly dissolved by aqueous solutions of acetic acid, but if potassium bichromate in sufficient quantity is added the magnesium becomes passive and no longer dissolves. If, however, the magnesium is made the anode in an acetic acid-bichromate solution it passes into solution, so that under these conditions it is active. The amount of bichromate necessary to make the magnesium passive depends on the concentration of the acetic acid, *e.g.*, 1 per cent. potassium bichromate is necessary in 5 per cent. acetic acid, whereas 2½ per cent. are required in 10 per cent. acetic acid. It is further noteworthy that the passivity can be done away with by the addition of a sufficient quantity of an alkali or magnesium salt of a stronger acid, *e.g.*, NaCl, $MgCl_2$, $MgSO_4$. The quantitative relations of the phenomena are being further studied. T. S. P.

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1763. *Amorphous Sulphur: Study of the Two Forms of Liquid Sulphur as Dynamic Isomers.* **C. M. Carson.** (Amer. Chem. Soc., Journ. 29. pp. 499–517, April, 1907.)—Experiments in support of the conclusions of Smith and his collaborators. I. The influence of catalytic agents on the rate of transformation of $S_\lambda \rightleftarrows S_\mu$. II. Influence of iodine on the state of equilibrium. III. The depression of the freezing-point of S_λ. IV. The thermal effects when liquid sulphur is rapidly heated or cooled. V. Actual form of equilibrium curve between 155° and 165°. VI. Change of concentration of S_μ when liquid sulphur is heated rapidly. VII. Dependence of the increase in viscosity on the rate of change of S_μ with temperature. VIII. Discussion on the cause of heat absorption. D. H. J.

1764. *The Blue Colour of Sulphur and of some of its Compounds.* **E. Paternò** and **A. Mazzucchelli.** (Accad. Lincei, Atti, 16. pp. 465–476, April 7, 1907.)—A preliminary study of (1) the blue variety of sulphur; (2) the blue colour of ultramarine; (3) the blue colour of potassium sulphocyanide under certain conditions; (4) the blue colour of sulphur sesquioxide; (5) the blue colour of some organic sulphur compounds. The paper is a record of miscellaneous observations, but does not enable a conclusion to be drawn as to the cause of the blue colour. D. H. J.

1765. *Yttrium Earths.* **C. James.** (Chem. News, 95. pp. 181–182, April 19, 1907.) In applying a new method for separating the yttrium earths, the author observes differences in the absorption spectra of erbium from different sources. The substance known as erbium is hence probably complex, as was found to be the case with didymium. T. H. P.

1766. *Artificial Colouration of Minerals.* **P. Gaubert.** (Comptes Rendus, 144. pp. 761–763, April 8, 1907.)—It has been noted by Suida that natural silicates which contain acid groups are only coloured by basic dyes such as methylene blue and fuchsine. The author's observations indicate that both acid and basic dyes are absorbed, and he therefore advocates the view that the process is purely physical. T. M. L.

1767. *Curved Capillary Layers and the Theory of Boiling.* **G. Bakker.** (Zeitschr. Phys. Chem. 59. pp. 218–248, April 30, and 60. pp. 464–468, Sept. 24, 1907. Ann. d. Physik, 23. 3. pp. 532–558, July 5, 1907.)—A theoretical paper. T. M. L.

1768. *Relation between the Crystalline Form and the Chemical Constitution of Simple Inorganic Substances.* **W. Barlow and W. J. Pope.** (Chem. Soc., Journ. 91. pp. 1150–1214, July, 1907.)—A further paper in which the authors' hypothesis of atomic structure and influence [Abstract No. 904 (1907)] is dealt with, and the results are applied to a number of elements and compounds. L. H. W.

1769. *The Equilibrium* $Ag_{(met)} + Ag^{\cdot} \rightleftharpoons Ag_2^{\cdot}$. **E. Bose.** (Zeitschr. Elektrochem. 13. pp. 477–478, July 26, 1907. Physikal.-chem. Laborat. d. techn. Hochschule, Danzig-Langfuhr.)—Using an apparatus similar in principle to that which Richards, Collins, and Heimrod used to demonstrate the equilibrium $Cu^{\cdot\cdot} + Cu \rightleftharpoons 2Cu^{\cdot}$, the author has shown that if metallic silver is left in contact with a solution of silver nitrate, silver ions are formed which have a lower valency than ordinarily, probably in accordance with the equation $Ag_{(met)} + Ag^{\cdot} \rightleftharpoons Ag_2^{\cdot}$. Quantitative measurements are deferred to a later date. T. S. P.

1770. *Manufacture of Steel Rails.* **J. C. Bayles.** (Cassier, 32. pp. 195–200, July, 1907.)—A general article. The author's view is that the best will be got from Bessemer converters by the use of dry blast; and by changing existing acid to basic converters when available ores require the removal of considerable phosphorus, it will not be possible for the open-hearth process to compete with the Bessemer for rail steel production. F. R.

1771. *Relation between Velocity and Volume of Organic Ions in Aqueous Solutions.* **G. A. Carse** and **T. H. Laby.** (Cambridge Phil. Soc., Proc. 14. pp. 1–12, March 6, 1907.)—A table is given showing the ionic volumes and ionic velocities of 49 organic kathions. The ionic volumes, of which the cube roots were taken to represent the linear dimensions of the ions, were determined by the ordinary method introduced by Kopp. T. M. L.

1772. *Purification and Testing of Selenium.* **R. Threlfall.** (Roy. Soc., Proc. Ser. A. 79. pp. 167–174, May 14, 1907.)—The method of purification used was essentially that of Ekman and Petherson (1876). Traces of tellurium could not be detected by the author spectroscopically. D. H. J.

1773. *Change of Structure in Iron and Steel.* **W. Campbell.** (Frank. Inst., Journ. 163. pp. 407–434, June, 1907.)—The author gives an account, with some little discussion, of current theory of the iron-carbon system. Complete details are given of tensile tests and microstructure of heat-treated steels containing from 0·7 to 2·04 per cent. carbon. The scheme of heat treatments consisted in heating samples to, and cooling from, temperatures of from 650° to 1,200° C., and the results agree with those generally known. F. R.

1774. *The Self-movement of the Particles in Colloidal Solutions.* **T. Svedberg.** (Zeitschr. Phys. Chem. 59. pp. 451–458, June 11, 1907. Chem. Universitätslaborat., Upsala, March, 1907.)—It has been repeatedly stated that the movement phenomena in colloidal solutions, and especially the Brownian movement of small suspended particles, is in apparent contradiction to the second law of thermodynamics [see Abstracts Nos. 1909 (1905) and 765 (1907)]. The author shows that, on the basis of our present knowledge of the movement of particles in colloidal solutions, it is possible to construct a system in which perpetual motion is realised. T. H. P.

1775. *Ionisation of Silver Nitrate Solutions. Elimination of the Contact Potentials of Liquids.* **A. C. Cumming.** (Faraday Soc., Trans. 3. pp. 218–220; Discussion, p. 221, Feb., 1907.) [See Abstracts Nos. 538, 543 (1907).]

1776. *Electromotive Forces of Concentration Cells.* **J. E. Trevor.** (Journ. Phys. Chem. 11. pp. 288-291, April, 1907.)—A mathematical deduction of the equation for the e.m.f. of concentration cells without migration, consisting in the integration of the Helmholtz equation on the assumption that the form of $p_1(\theta, h)$ is given by $\log (p_0 p_1) = (1 + a)n_1 n_2$ and of the correctness of the Ostwald dilution law; also integration assuming the dilution law of Rudolphi-van't Hoff. A. F.

1777. *Estimation of Antimony by the Electro-analysis of Solutions of its Thiosalts.* **H. J. S. Sand.** (Zeitschr. Elektrochem. 13. pp. 326-327, June 14, 1907. University College, Nottingham, May 25, 1907.)—Using his special apparatus for the rapid electro-deposition of metals by means of graded potentials, the author confirms the experiments of Foerster and Wolf, Dormaar, and others, viz., that in the electrolytic deposition of antimony from solutions of its thiosalts too high results are obtained [see Abstracts Nos. 982, 988, and 1265 (1907)]. T. S. P.

1778. *Action of Nitric Acid on Alloys.* **C. Montemartini** and **E. Colonna.** (Accad. Sci. Torino, Atti, 42. 9. pp. 847-860, 1906-1907.)—An investigation of the action of an excess of nitric acid upon alloys of Zn with Mg, Al, Cd, Bi, Sn, Cu, and Ag. W. H. St.

1779. *Ionisation of Chromic Sulphates.* **A. Colson.** (Comptes Rendus, 144. pp. 637-639, March 18, 1907.)—Aqueous solutions which contain the molecule $Cr_2(SO_4)_3$ in different states have all the same cryoscopic molecular depression of the freezing-point, viz., 4·2. The conclusion is drawn that cryoscopic variations depend on the number of chemical molecules in solutions, and not on the electrical conductivity. D. H. J.

1780. *Contact Charge between a Porous Partition and Saline Solutions.* **H. E. van der Ven.** (Archiv. Musée Teyler, 10. pp. 433-460, 1907.)—The author continues his study of the electric contact charge for a number of salts, but finds no general relation, either between the values of the transporting forces and the constitution of the salt solutions transported, or between the latter and the electric charges of the walls. [See also Abstract No. 1977 (1906).] T. H. P.

1781. *The Nernst Theory and Liquid Chains with Identical Ends.* **J. Guyot.** (Comptes Rendus, 144. pp. 832-834, April 22, 1907.)—The Nernst-Planck equation has been applied experimentally by Negbaur and Nernst to a certain number of liquid chains at 18°, in the particular case where the solutions contained binary electrolytes formed of univalent ions; the results showed a concordance between the observed and calculated e.m.f.'s. In the case of binary electrolytes with polyvalent ions corresponding equations may be deduced; these equations have been experimentally confirmed by the author, for a certain number of chains. D. H. J.

1782. *Use of Rotating Anode in Electrolytic Precipitation of Uranium and Molybdenum.* **E. T. Wherry** and **E. F. Smith.** (Amer. Chem. Soc., Journ. 29. pp. 806-808, June, 1907. Contribution from the John Harrison Lab. of Chemistry.)—Conditions are given for the quantitative precipitation of Ur and Mo by electrolysis. Molybdenum can be readily separated from the alkali metals in this way. T. H. P.

1783. *The Kathode in an Electrolytic Cell as Autoxidiser.* **O. Mumm.** (Zeitschr. Phys. Chem. 59. pp. 492-496, June 11, 1907. Habilitationsschrift, Kiel.) F. J. B.

1784. *The Anode of an Electrolytic Cell as Acceptor in Autoxidation Reactions.* **O. Mumm.** (Zeitschr. Phys. Chem. 59. pp. 497-506, June 11, 1907. Habilitationsschrift, Kiel.) F. J. B.